9513385.0206

START

0042489

WHC-SD-WM-EV-107, Rev 0

UC-2030

Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement

P. L. Kline
H. Hampt
W. A. Skelly

Date Published
July 1995

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company P.O Box 1970 Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

9513385.0207

JUL 19 1995

ENGINEERING DATA TRANSMITTAL

1. EDT № 612618

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Geotechnical Development Projects	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: P. L. Kline	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the No Separations Alternative, the Extensive Separations Alternative, the Tri-Party Agreement Alternative, and the In Situ Disposal Alternative. Environmental, Safety, and QA approvals required by WHC-CM-3-5 Section 12.7 were obtained on Rev. B of this document. The only significant changes in this revision, relative to Rev. B, involved changes to data tables addressing construction staffing requirements and costs.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		0	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. P. L. Kline [signature]			
2	1	Cog. Mgr. J. G. Field [signature] 7/18/95			
		QA (approved by J. Weber, on EDT dated 3/6/95 attached)			
		Safety (approved by J. M. Garcia, on EDT dated 3/6/95 attached)			
		Env. (approved by R. H. Engelmann, on EDT attached)			

18.	19.	20.	21. DOE APPROVAL (if required)
P. L. Kline [signature] 7/15/95 Signature of EDT Originator Date	[signature] L. E. Borneman 7/18/95 Authorized Representative for Receiving Organization Date	J. G. Field [signature] Cognizant Manager Date	Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments [X] Not Required per Waiver WA-557

BD-7400-172-2 (04/94) GEF097

BD-7400-172-1

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) TWRS Compliance Plans	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: P.L. Scanlon	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement (EIS). Data in this document complements data provided in separate documentation for the In-Situ Disposal Alternative, the No Separations Alternative, the Extensive Separations Alternative, and the TPA Preferred Alternative. Data in this document are based on (a) landfill closure of the DST and SST tank farms, including in situ stabilization of underground waste storage tanks and ancillary tank farm equipment, (b) no cleanup or stabilization of contaminated soil, and (c) placement of an engineered surface barrier over tank farms and low-level waste disposal vaults. This EDT transmits the Closure Engineering Data Package to TWRS Compliance Plans as Rev. B, for DOE-RL approval, per WHC-CM-3-5, section 12.7.		9. Equip./Component No.: n/a 10. System/Bldg./Facility: n/a
11. Receiver Remarks: n/a		12. Major Assm. Dwg. No.: n/a 13. Permit/Permit Application No.: n/a 14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		B	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	1	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. P.L. Scanlon	[signature]	2/28/95	R2-06						

9513385.0208

1	1	Cog.Mgr. L.E. Borneman LEBorneman 2/28/95 2/28/95 R2-06			
1	1	QA J. Weber 3/6/95 S1-57			
1	/	Safety J.M. Garcia R3-09			
1	1	Env. R.H. Engelmann H6-26			
1	1	Disp.Pro. J.O. Honeyman S7-81			

18.	19.	20.	21. DOE APPROVAL (if required)
P.L. Scanlon 2/28/95 Pat Scanlon Signature of EDT Originator — Date	LEBorneman 2/28/95 L.E. Borneman 2/28/95 Authorized Representative for Receiving Organization — Date	LEBorneman 3/7/95 L.E. Borneman 2/28/95 Cognizant Manager — Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

9513385.0209

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-EV-107, REV 0
Document Title:	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement
Release Date:	7/18/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz 7/18/95

Kara M. Broz

9513385.0210

SUPPORTING DOCUMENT

SUPPORTING DOCUMENT	1. Total Pages 125

2. Title	3. Number	4. Rev No.
Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	WHC-SD-WM-EV-107	0

5. Key Words	6. Author
closure, grout filling, gravel filling, ancillary equipment stabilization, Hanford barrier, environmental impact statement, NEPA	Name: P. L. Kline Pat Kline Signature Organization/Charge Code 0M634/D1DDB

7. Abstract

This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the In Situ Disposal Alternative (WHC-SD-WM-EV-101), the No Separations Alternative (WHC-SD-WM-EV-103), the Extensive Separations Alternative (WHC-SD-WM-EV-100), and the Tri-Party Agreement Alternative (WHC-SD-WM-EV-104). Data provided relate to impacts from construction and postclosure monitoring and maintenance, resource utilization, transportation, cost, and schedule. Unit processes addressed include single-shell tank (SST) closure, double-shell tank (DST) closure, and barrier construction.

8. RELEASE STAMP

OFFICIAL RELEASE
BY WHC
DATE JUL 19 1995
Sta 4.

9513385.0211

WHC-SD-WM-EV-107, Rev 0
UC-2030

Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement

P. L. Kline
H. Hampt
W. A. Skelly

Date Published
July 1995

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company P.O Box 1970 Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TERMS

cm	centimeters
cm^3	cubic centimeters
DOE	U.S. Department of Energy
DST	double-shell tank(s)
EIS	Environmental Impact Statement
ft	feet
ft^3	cubic feet
g	gram
HEPA	high-efficiency particulate air (filter)
HLW	high-level waste
in.	inches
kg(s)	kilogram(s)
km	kilometer
lb(s)	pound(s)
LLW	low-level waste
m	meter(s)
m^3	cubic meters
mi	mile
MUST	miscellaneous underground storage tanks
RCRA	*Resource Conservation and Recovery Act of 1976*
ROD	Record of Decision
SDRI	Sealed Double-Ring Infiltrometer Test
sec	second
SST	single-shell tank(s)
TRU	transuranic waste
TWRS	Tank Waste Remediation System
yd^3	cubic yards

This page intentionally left blank.

1.0 INTRODUCTION

On January 28, 1994, the U.S. Department of Energy (DOE) printed a Notice of Intent in the Federal Register, announcing that an environmental impact statement (EIS) would be prepared for the disposal of waste in 177 underground storage tanks at the Hanford Site, under the Tank Waste Remediation System (TWRS) program. The EIS will be a joint document between the DOE and the Washington Department of Ecology (Ecology). The Notice of Intent included a discussion of the TWRS program, the scope of the EIS, and the proposed actions, alternatives, and public involvement in the decision process. The purpose of the TWRS-EIS is to identify and evaluate the impacts of the proposed actions in the recently-amended Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1994). The TWRS-EIS will also evaluate other alternatives identified in the Notice of Intent and in public meetings. The following five alternatives are addressed in the TWRS-EIS:

No disposal action
In situ disposal
Extensive pretreatment
No separations
Tri-Party Agreement preferred alternative

The Jacobs Engineering Company has been selected by the DOE to prepare the TWRS-EIS. In order to conduct an assessment of environmental impacts, technical data relating to each alternative is provided to Jacobs Engineering by the Westinghouse Hanford Company in the form of engineering data packages. The Jacobs Engineering Company will be responsible for hazard assessment, groundwater impact evaluation, radionuclide transport, and other environmental impact assessments.

The Tri-Party Agreement includes two milestones which have a direct impact on the TWRS program: milestones M-45-00 and M-45-03-T01. Milestone M-45-00 requires complete closure of all single-shell tank (SST) farms by September 2024. Specifically, it requires tank waste residues not to exceed 10.2 cubic meters (m^3) (360 cubic feet [ft^3]) in each 100 series tank, and 0.85 m^3 (30 ft^3) in each 200 series tank. Milestone M-45-03-T01 states that complete SST waste retrieval is achieved when no less than 99 percent of the waste inventory is removed from the tank. These two milestones provide the basis for the 99 percent clean scenario.

This engineering data package contains information related to landfill closure of SSTs, double-shell tanks (DSTs), and miscellaneous underground storage tanks (MUSTs) and other ancillary equipment associated with SST operable units. It also contains information associated with landfill disposal of the vitrified low-level waste (LLW). The data reflects the 99 percent clean scenario. If 100 percent clean is the ultimate goal, the data will have to be modified. For efficiency and consistency, a standalone engineering data package is prepared to address closure in each engineering data package.

This page intentionally left blank.

2.0 BACKGROUND

The underground storage tanks, for which closure must be addressed, include 149 SSTs, 28 DSTs, and approximately 28 MUSTs and other ancillary equipment associated with SST operable units. The number of MUSTs is currently under review and may be subject to change. Together, the tanks contain approximately 61 million gallons of radioactive waste. In addition to the waste in the tanks, the EIS will also address the disposal of nearly 2,000 cesium and strontium capsules containing radioisotopes recovered from the tank waste.

The TWRS-EIS replaces the *Environmental Impact Statement for Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes* (HDW-EIS), issued in 1987 (DOE 1987). The record of decision (ROD) for the HDW-EIS was issued in April 1988, (DOE 1988) and included information about the retrieval of DST waste, pretreatment in an existing facility (tentatively B Plant), construction of the Hanford Waste Vitrification Plant to vitrify the pretreated high-level waste (HLW) stream, and onsite disposal of the LLW waste stream as grout. The ROD deferred the decision on disposal of the SST wastes pending further technology development and evaluation.

Since its publication, several developments have invalidated the decisions documented in the ROD. These include the identification of safety issues associated with the storage of tank wastes (such as hydrogen generation, the presence of ferrocyanides, and high heat), the decision not to use B Plant for pretreatment purposes, and amendments to the Tri-Party Agreement in 1994 that required retrieval and ex-tank disposal of SST wastes.

The *Tank Waste Technical Options Report* (Boomer et al. 1993), identified and evaluated waste disposal alternatives, and supported the strategy adopted in the amended Tri-Party Agreement. Data developed for the alternatives considered in the *Tank Waste Technical Options Report* are relevant to the alternatives to be evaluated in the TWRS-EIS, and are used as a basis for much of the engineering data provided in this document.

This page intentionally left blank.

3.0 DESCRIPTION OF CLOSURE ACTIVITIES

There are five distinct treatment alternatives presented in detail in other data packages that support the TWRS EIS effort. A brief summary of each of these data packages follows.

The *No Disposal Action Alternative for Remediating Tank Waste and Cesium and Strontium Capsules* (Meng 1995) states that waste would remain in both SSTs and DSTs for the next 100 years. Free liquids would be pumped out of SSTs; otherwise no treatment of the wastes would occur. Every 50 years, the tanks would be replaced. No closure activities would be related to this alternative.

The *In Situ Treatment and Disposal of Radioactive Waste in Hanford Site Underground Storage Tanks Engineering Data Package for the Tank Waste Environmental Impact Statement* (McConville 1995) explores three options for treating SST and DST wastes in situ. The first option, in situ vitrification, would melt the waste and the tanks into a glass monolith to contain the contaminants for geologic periods of time. The second option, in situ chemical stabilization, would combine grout with tank waste to reduce the waste's mobility. The third options, radio frequency drying, would remove the liquid from the waste using radiant heat from a radio frequency generator. The remaining tank void would be filled with gravel to provide stabilization. The only closure activities related to this alternative would involve barrier construction and monitoring since tank and ancillary equipment stabilization have been covered in the in situ treatment and disposal alternative.

The *No Separations Data Package for the Tank Waste System Environmental Impact Statement* (Colby 1995) states that the wastes would be retrieved from SSTs and DSTs. There would be no separation of wastes into HLW and LLW streams and no pretreatment of LLW to remove cesium. The SST and DST wastes would be blended together in a mix classified as HLW, vitrified into glass cullet, and packed into canisters and overpack casks. The casks would be shipped to a permanent HLW repository for final disposal. No LLW vaults would be used in this alternative. Closure activities related to this alternative would include tank and ancillary equipment stabilization, barrier construction, and tank farm monitoring.

The *Extensive Pretreatment Data Package for the Tank Waste System Environmental Impact Statement* (Jansen 1995) states that waste would be retrieved from SSTs and DSTs and separated into HLW and LLW fractions. After separation, two options are provided. In the first option, HLW and LLW fractions would be vitrified; then the HLW glass would be shipped offsite to a permanent repository, and the LLW glass would be disposed of onsite in a polymer/sulfur matrix. In the second option, both HLW and LLW would be vitrified; then the HLW glass would be shipped offsite to a permanent repository, and the LLW glass would be disposed of onsite in a grout matrix. Closure activities related to this alternative would include tank and ancillary equipment stabilization, barrier construction, and tank farm and LLW vault monitoring.

The *Tri-Party Agreement Alternative Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Slaathaug 1995) states that waste would be retrieved from SSTs and DSTs and separated into HLW and LLW in the following three steps: 1) soluble wastes would be separated from insoluble wastes; 2) enhanced washing would be done to decrease the amount of HLW; and 3) cesium would be removed from the LLW. Both HLW and LLW would be vitrified, then the HLW would be shipped offsite to a permanent repository, and the LLW would be disposed of onsite in a polymer/sulfur matrix. Closure activities related to this alternative would include tank and ancillary equipment stabilization, barrier construction, and tank farm and LLW vault monitoring.

Closure activities apply to the TWRS-EIS disposal alternatives in the following relationships:

- Both the SSTs and DSTs would be stabilized to prevent dome collapse by grout filling or gravel filling in the extensive pretreatment, no separations, and Tri-Party Agreement preferred alternatives. These stabilization options also are included in the in situ treatment and disposal alternative. Therefore, tank stabilization is not addressed for in situ treatment and disposal in this closure package.

- Ancillary equipment would be grout-filled for stabilization in all treatment alternatives with the exception of the no disposal action alternative. Ancillary equipment would not be excavated or packaged.

- Surface barriers would be placed over SSTs and DSTs for all alternatives with the exception of the no disposal action alternative. Barriers will also be placed over the LLW vaults described in the extensive pretreatment alternative and in the Tri-Party Agreement preferred alternative.

The following assumptions are made:

- The 99 percent clean requirement for SSTs and the 99.9 percent clean requirement for DSTs refers to waste volumes in the tanks. It does not include the soil surrounding the tanks or the ancillary equipment.

- No soil remediation would be required for the purposes of this data package. The Hanford Barrier, when placed over the stabilized tanks and ancillary equipment, would be sufficient to prevent precipitation and runoff from causing migration of wastes in the soil. The barrier would meet or exceed all other performance requirements.

- All permitting activities, safety and accident plans, quality assurance and quality control plans, sampling plans, tank structural integrity testing, group formulation testing and any other similar activity has been performed prior to the beginning of closure activities. Therefore, it is not necessary to reflect their costs in this document.

- As far as costs go, this document is a bounding document; other less expensive or less time-intensive solutions may exist to the tank farm closure.
- All workforce cost estimates are for a 40-hour week and a 250-day work year.

Tank stabilization, ancillary equipment stabilization, and barrier construction are discussed in detail in the following sections.

3.1 TANK STABILIZATION

Both SSTs and DSTs would be stabilized for subsidence and to reduce contaminant mobility. Two options are under consideration: grout filling (see Section 3.1.1) and gravel filling (see Section 3.1.2).

3.1.1 Grout Filling

Tank stabilization would be performed by mechanically combining residual tank waste with a grout mixture to provide a more stable matrix than the dregs alone. Grout would reduce the mobility of the waste and would combine with nitrates in the waste to decrease their mobility. Successful demonstrations of grout stabilization using up to 1.4:1 ratios of waste to grout (by volume) have been performed at the Hanford Site. Grout stabilization would be performed in all alternatives except for the no disposal action alternative. This method of stabilization also is delineated in the in situ alternative. However, the confinement structure described by the in situ alternative is not used by the closure data package. In each alternative, SSTs are assumed to be 99 percent retrieved (that is, 1 percent waste by volume would still remain), and DSTs are assumed 99.9 percent retrieved (that is, 0.1 percent waste by volume would still remain). The following sections describe the grouting process, a schedule for tank stabilization, and the engineering cost for tank stabilization including design, equipment cost, personnel and materials.

3.1.1.1 Description of Grouting Process. The grout-fill process would fill the void space in SSTs and DSTs, as well as ancillary equipment (see Section 3.2.2), with grout. The process is based on established commercial techniques used in construction and mining industries. The feasibility of using grout fill in the W-025 Burial Ground on the Hanford Site has been studied. Because grout fill operations would displace vapor from the tanks, a high-efficiency particulate air (HEPA) system would be attached to one vent pipe on each tank. Depending upon the types of gases present, more than one HEPA filter may be required to eliminate personnel safety hazards. All other access pipes to the tank would be sealed with the exception of the dedicated piping network. Grout would be mixed and pumped through this piping network to distributors located on tank risers. Grout could be placed in lifts or layers to optimize the grout curing process. Control-density fill grout (a self-leveling grout), which has a soupy consistency prior to curing, would be used.

The grouting process would begin with tank preparation and the installation of grout distributors on tank risers. If risers were not available or suitable, new risers could be installed. With distributors installed, a dedicated piping network would be assembled and connected to the grout plant which would be centrally located within a tank farm group.

Dry materials would be mixed at a batch plant conveniently located to serve all tank farms, at the south end of Pit 30, near Route 3. The plant would receive all dry components for the grout, except for the air entrainment additive, and would combine them in correct proportions. The dry mixture would then be transported by hauler to the grout plant.

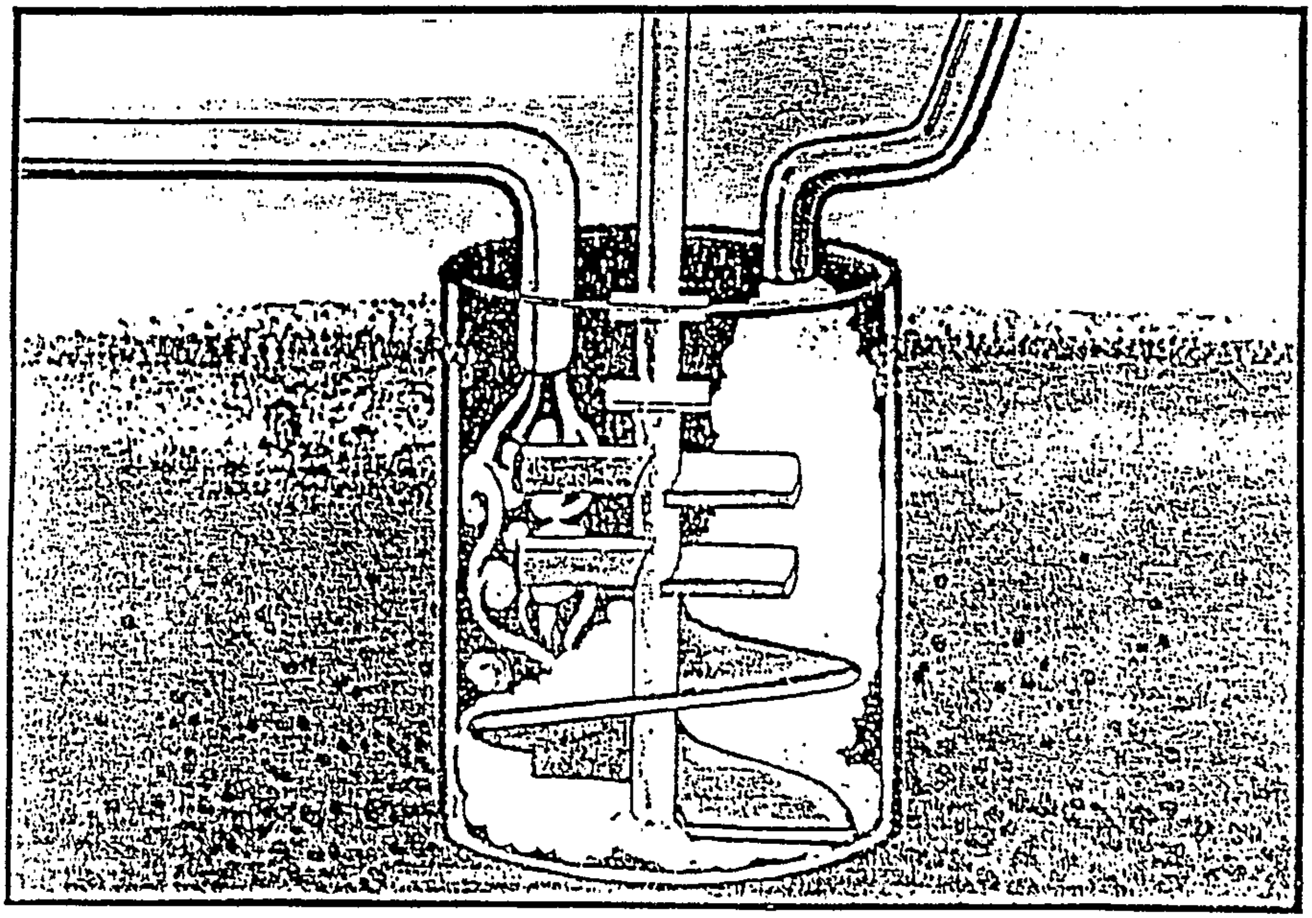
The grout plant would receive the dry material, mix it with water and air entrainment additives, then pump it to the tank distributors. The process would be controlled and monitored as lifts were poured and tanks were filled. If necessary during the first lift, an auger system (see Figure 3-1) could be installed to thoroughly mix the residual waste with the grout. A typical 3,800 m^3 (1,000,000 gallon [gal]) tank could be filled in 105 days (see Appendix A, Table A2 for a complete schedule). If the curing time for individual lifts between pours was lengthened, this period would be extended.

Grout distributors would be strategically placed within tank risers to assure uniform distribution of grout within the tank. A flexible, portable piping network would serve the tank sites with flexible piping to the distributors. Where operations were performed within a preexisting confinement structure (a tank riser which is available and suitable), grout-feed piping would be integrated with the structure. The valving and feed capacity of the network would be such that grout could be uniformly fed to all distributors simultaneously. Each distributor would be equipped with a discharge nozzle that would be remotely positioned to satisfy discharge requirements.

At the end of the grout fill operation, related equipment would be moved to another tank or disposed of, and tank openings would be sealed. The HEPA-filters would remain in place until radionuclide air samples indicated that emission rates had decreased to levels below regulatory concern, then would be stabilized and disposed of. Tank contents would be monitored as needed, and the tank site would be secured pending placement of the surface barrier. The grout stabilization process also would be used for stabilizing ancillary equipment (also known as *Resource Recovery and Conservation Act* of 1976 [RCRA] past practice units) (see Section 3.2).

The success of the grout-fill operation would depend upon the demonstration and verification that required uniformity was achieved. The grout formulation would be self-leveling, but a monitoring system would be put into place to verify hydration of the grout without excessive cracking or shrinking.

Figure 3-1. Grout Mixing System.



3.1.1.2 Schedule for Tank Stabilization. To perform tank stabilization with maximum efficiency and minimum cost, there would be two grout plants. Single-shell tanks and their ancillary equipment would be stabilized first, then DSTs and their ancillary equipment. One grout plant would be located in the center of 200 East Area Tank Farms; the other in the center of the 200 West Area Tank Farms. The following tank clusters would be served:

200E	241-T, 241-TX, and 241-TY 241-S, 241-SX, 241-U, and 241-SY
200W	241-A, 241-AX, 241-AW, 241-AP, 241-AY, and 241-AZ 241-B, 241-BX, 241-BY, 241-C, and 241-AN

3.1.1.3 Engineering Cost for Tank Stabilization. The total tank volume of all SSTs and DSTs is approximately 761,000 m^3 (see Appendix A, Table A1); currently, there are approximately 467,000 m^3 of waste in these tanks. The total tank volume of Tank C-106, which is a 530,000 gal tank, was estimated by computer modeling. The value was compared to the tank capacity, which is the amount of waste the tank contains, and a scaling factor of 1.6 was calculated. This scaling factor was used to estimate the size of all other tanks. In the TWRS-EIS extensive pretreatment, no separations, and Tri-Party Agreement alternatives, it is assumed that 99 percent of the SST waste and 99.9 percent of the DST waste will have been retrieved prior to closure. Therefore, there would be 1,355 m^3 of waste and approximately 760,000 m^3 of void space remaining in the tanks.

For every 1 m^3 (35 ft^3) of grout, the constituents of the grout mixture would be as follows: 1,660 kilograms (kgs) (3,660 pounds [lbs]) of sand, 180 kgs (397 lbs) fly ash, 150 kgs (331 lbs) water, 20 kgs (44 lbs) Type I/II portland cement, and 0.45 kg (1.00 lb) of air entrainment additive. Therefore, for 760,000 m^3 of void space, approximately 1,260,000,000 kgs of sand, 137,000,000 kgs of fly ash, 114,000,000 kgs of water, 15,000,000 kgs of cement, and 341,000 kgs of air entrainment additive would be required.

The major constituent for the grout is sand. Sand would be excavated from Pit 30, located between the 200 East and 200 West Areas. The pit currently has a footprint of 20,930 m^2 (5.2 acres), and would be expanded by another 253,000 m^2 (62.5 acres). A one-way trip is approximately 5 kilometers (km) (3 miles [mi]). A bottom-dump (or belly-dump) truck can haul about 7.6 m^3 (10 cubic yards [yd^3]) of sand. Assuming the sand has a density of about 1,280 kg/m^3, almost 164,000 trips would be required. Cement is manufactured in Durkee, Oregon (approximately 291 km [181 mi] from the Tri-Cities) and would be brought by railcar. Each railcar is assumed to carry 90,700 kgs (100 tons) of cement. For 15,000,000 kgs of cement, 165 railcars would be required. The Centralia Steam Plant in Centralia, Washington, which has a one-way trip of 300 km (186 mi), would provide the fly ash in 90,700 kg (100 ton) railcars. For 137,000,000 kgs of fly ash, 1,510 railcars would be necessary.

To store such large quantities of material, storage tanks or silos would have to be constructed for cement and fly ash. These facilities would keep the dry materials from precipitation and wind erosion. The cost of constructing and maintaining such facilities over the life of the construction project could be included in the batch plant costs.

A portable dry mix facility would cost approximately \$100,000; a portable batch plant with a throughput capacity of 115 m^3 per hour (150 yd^3 per hour) costs approximately \$500,000. This price also would include a dust collection system, a plant charging system for wet mix operation, and a 10-yard capacity plant mixer. However, the trailer for the plant mixer would have to be modified to prevent the rig from tipping over when the drum was tilted. Modification to the trailer, such as adapting the outriggers of cranes, could cost an additional \$100,000.

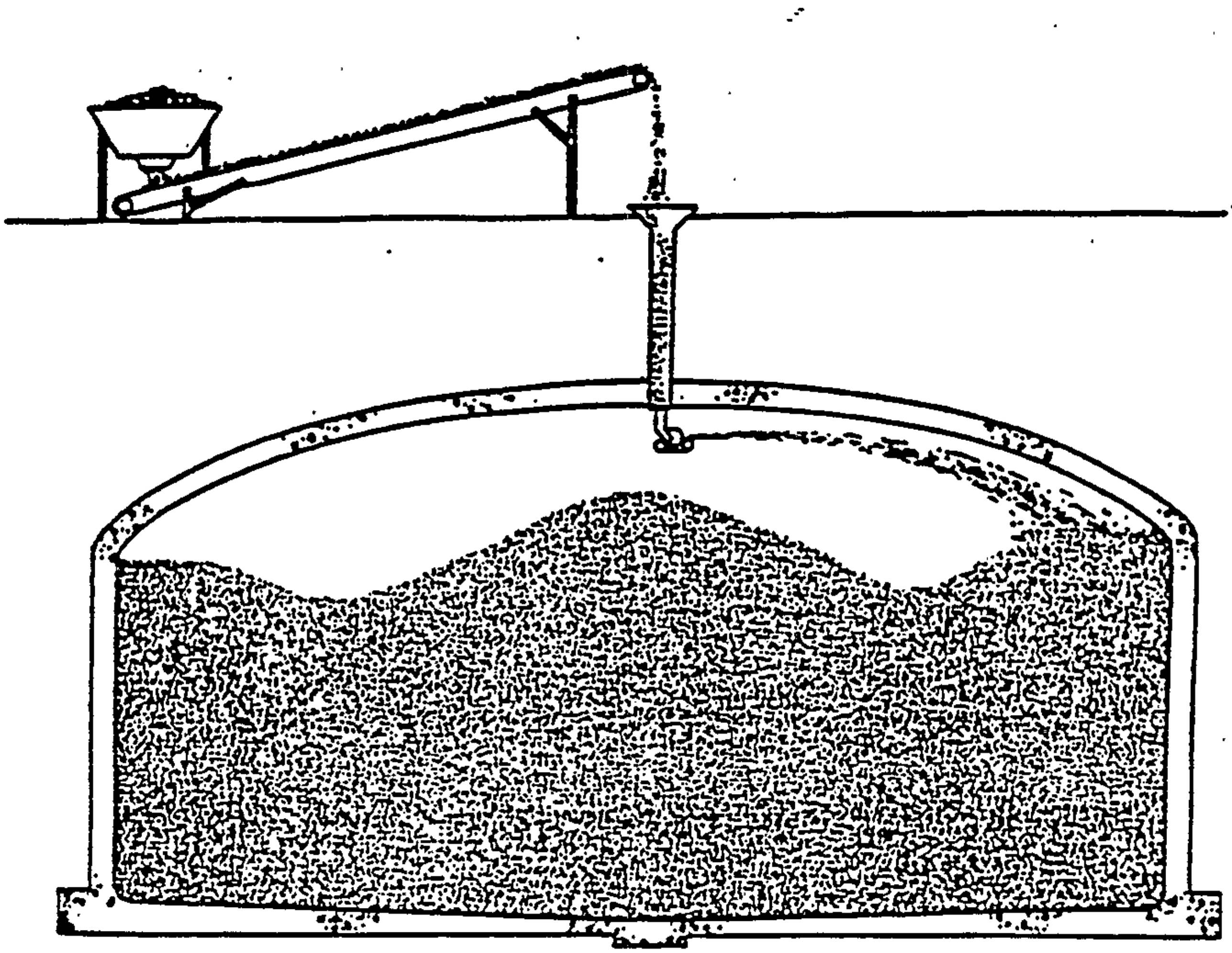
3.1.2 Gravel Filling

Rather than stabilizing the tanks with a chemical grout matrix, such as the control density fill method described above, gravel could be used. Tanks would be filled completely (100 percent) with gravel. The gravel fill would not control the reactivity of the nitrates, but it would accomplish physical stabilization of the tanks. Crushed and/or screened aggregate has an assumed density of around 1,920 kg/m^3 (120 lb/ft^3). The same assumptions are made regarding the residual waste amounts in the SSTs and DSTs as those listed in Section 3.1.1.3.

3.1.2.1 Gravel Fill Process Description. The gravel fill process would involve the uniform distribution of sized crushed rock throughout the tank including the tank dome, using a gravel slinger. This commercially proven technology is used in filling ship holds and silos with materials such as grain or cement. Tests performed at the Hanford Site (RHO 1983b) have verified the use of this technology with local materials in a tank-like environment. An artist rendering of this technology is shown in Figure 3-2.

Currently, SSTs contain a variety of equipment such as purge tubes, suspended and anchored air lift circulators, failed pumps, etc. In-tank equipment must be evaluated regarding its potential to impede the distribution process or to create undesirable voids. If unacceptable, the equipment may need to be removed or require multiple slingers to fill around obstacles. Using multiple slingers could require additional risers in the tank dome. Additional risers also could be required for monitoring equipment. Installation of slingers would require modifications to existing pits and risers. Monitoring equipment and instrumentation would require placement within the tank before filling. All tank preparation work would have to occur before the fill activities could begin. Since gravel fill operations would displace vapor from the empty tanks, a portable confinement structure (HEPA filter system) would be installed to control air emissions. This structure would measure 3.7 m x 3.7 m x 3 m (12 ft x 12 ft x 10 ft).

Figure 3-2. Typical Gravel Filling Configuration for Tanks.



The crushed aggregate would be obtained from Pit 30 and delivered to four stockpiles in tank farm areas. Each stockpile would serve the following tank farms:

200E	241-T, 241-TX, and 241-TY 241-S, 241-SX, 241-U, and 241-SY
200W	241-A, 241-AX, 241-AW, 241-AP, 241-AY, and 241-AZ 241-B, 241-BX, 241-BY, 241-C, and 241-AN

Each stockpile would be served by a loader equipped with tires for loading a conveyor network. The network would serve one tank at a time. Because the time to fill a tank a tank is no more than a few operating days, the conveyor runs would be assembled from mobile sections to be repositioned by a crane, as required. After Pit 30 is finished being used for borrow material, it will be filled in until the land is returned to its original contours.

Gravel would be distributed in the tank with a slinger, a mechanism that is suspended in the tank, typically from the center riser. The slinger would capture gravel on a fast-moving horizontal belt, then throw it as it slowly rotated. The belt speed, belt angle, gravel feed rate, and rotational speed would be the primary controlling parameters. A hopper, mounted directly above the slinger, would be fed from the conveyor system and, in turn, would feed the slinger through a quick-acting isolation valve. The valve would not be used to control feed flow to the slinger but would be to isolate the slinger from the ambient environment if tank differential pressure was threatened.

Feed to the hopper would work with the isolation valve. An enclosure, placed around the slinger/hopper assembly, would serve as a confinement buffer not a confinement zone. Conditions could require more than one slinger in a tank. Installed hardware, which could not be removed, might require more than one slinger. The availability of existing risers versus the difficulty of installing new risers also could drive the decision to use more than one slinger. These somewhat smaller slingers could operate like the larger, center-mounted unit. For the purposes of this report, it is assumed that all tanks would use a larger, center-mounted unit. Sacrificial material vibrators could be strategically placed within the tanks to assure maximum fill in critical areas.

3.1.2.2 Special Gravel-Fill Requirements. The heating, ventilating and air conditioning system used must provide sufficient capacity and controls to assure that process operations could not upset the tank pressure differential. Gravel filling would generate a considerable volume of airborne particulates that would have to be separated and removed from the exhaust stream. A series of cyclone separators would be used to remove the particulate from the exhaust before passing through a dual-stage testable HEPA-filter system. Used HEPA filters may be disposed of inside the tanks in order to avoid separate waste disposal costs. There may be other costs associated with such in situ disposal, but they have not been calculated.

The success of the filling operation would depend on demonstrating and verifying that required fill distribution and uniformity was achieved. The fill monitoring system would be able to visualize interior tank operations, and a vision system would be able provide imaging through airborne dust. Fill surface elevation measurement and mapping in real time would be available to document the progress of the operation and to verify results. Density and compaction measurement also would be used to verify fill integrity.

3.1.2.3 Engineering Cost for Gravel-Fill Stabilization. The tank waste retrieval process would leave 1 percent waste in the SSTs. The smaller tanks (16 each holding 208 m^3 [55,000 gal]) would be stabilized by grouting rather than gravel fill because they are too small to contain the gravel dispersing mechanism. For this reason, the void volume of the remaining SSTs and DSTs is about 751,000 m^3. This volume of gravel would be removed from Pit 30. The gravel would be transported by end-dump trucks capable of hauling 6 m^3 (10 yd^3) of gravel per trip. Therefore 125,000 trips would be necessary for filling the SSTs and DSTs.

3.2 ANCILLARY EQUIPMENT STABILIZATION

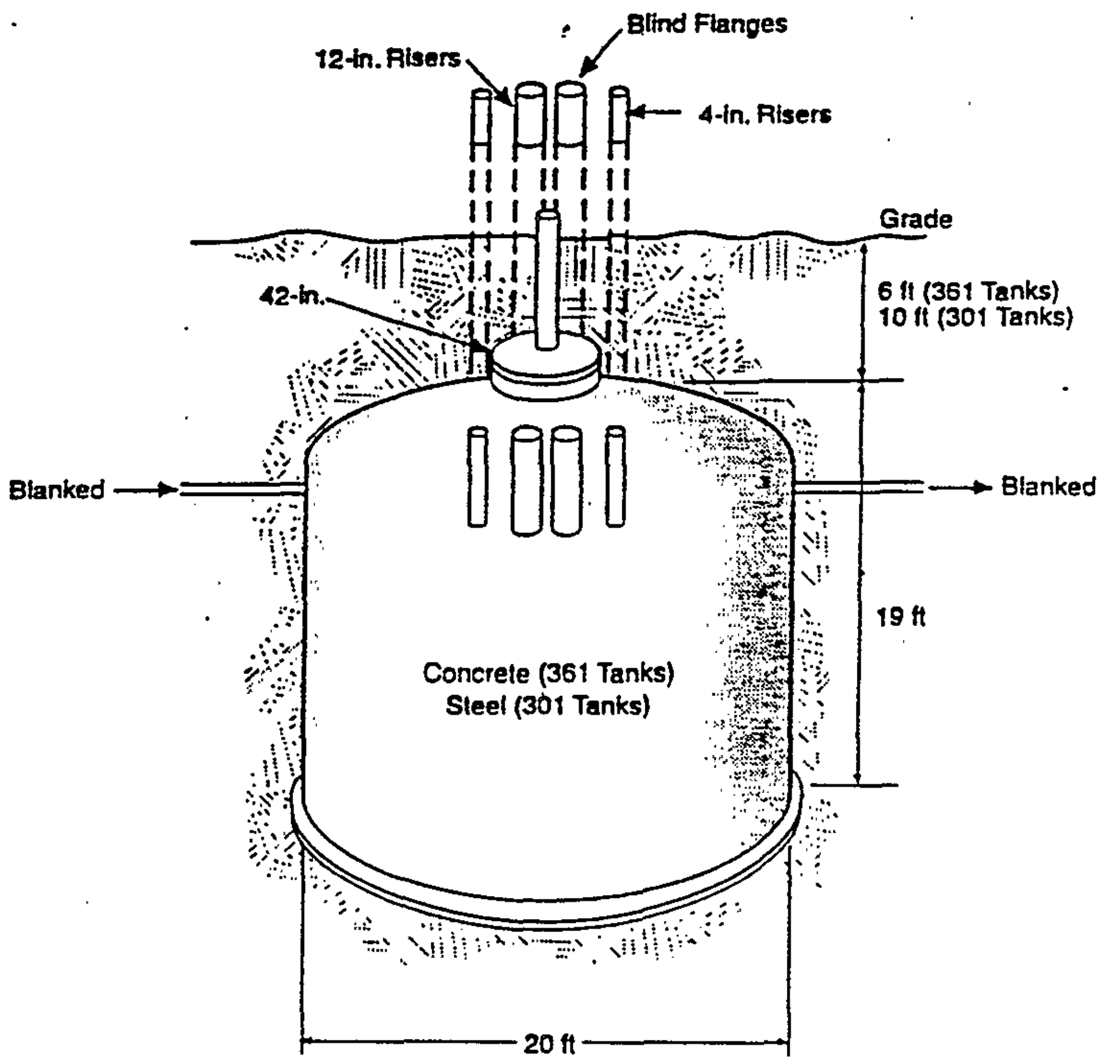
3.2.1 Disposition of Ancillary Equipment

For all alternatives considered in the TWRS EIS except the no disposal action alternative, closure would apply to SSTs, DSTs and the ancillary equipment associated with both groups of tanks. Ancillary equipment would include the following: diversion boxes, catch tanks, valve and pump pits, process pits, diverter stations, receiver vaults, condensate tanks, risers, transfer piping and piping encasements associated with single-shell tank operations. Pipelines would include the following: lines between tanks and to process facilities, air and steam supply lines, raw water lines, and drains. See Figures 3-3 through 3-7 for representative sketches of miscellaneous underground storage tanks.

During closure of tank farms, ancillary equipment items would be stabilized in place (i.e., disposed of). In situ stabilization would consist of filling all voids with an appropriate grout material (a chemical grout or cement grout product). The physical immobilization of contaminants provided by the grout could be augmented by the use of sequestering agents, such as zeolites, that would be capable of chemical bonding with contaminants. If ancillary equipment was plugged at one or more points, several access ports would have to be installed to ensure complete grout filling.

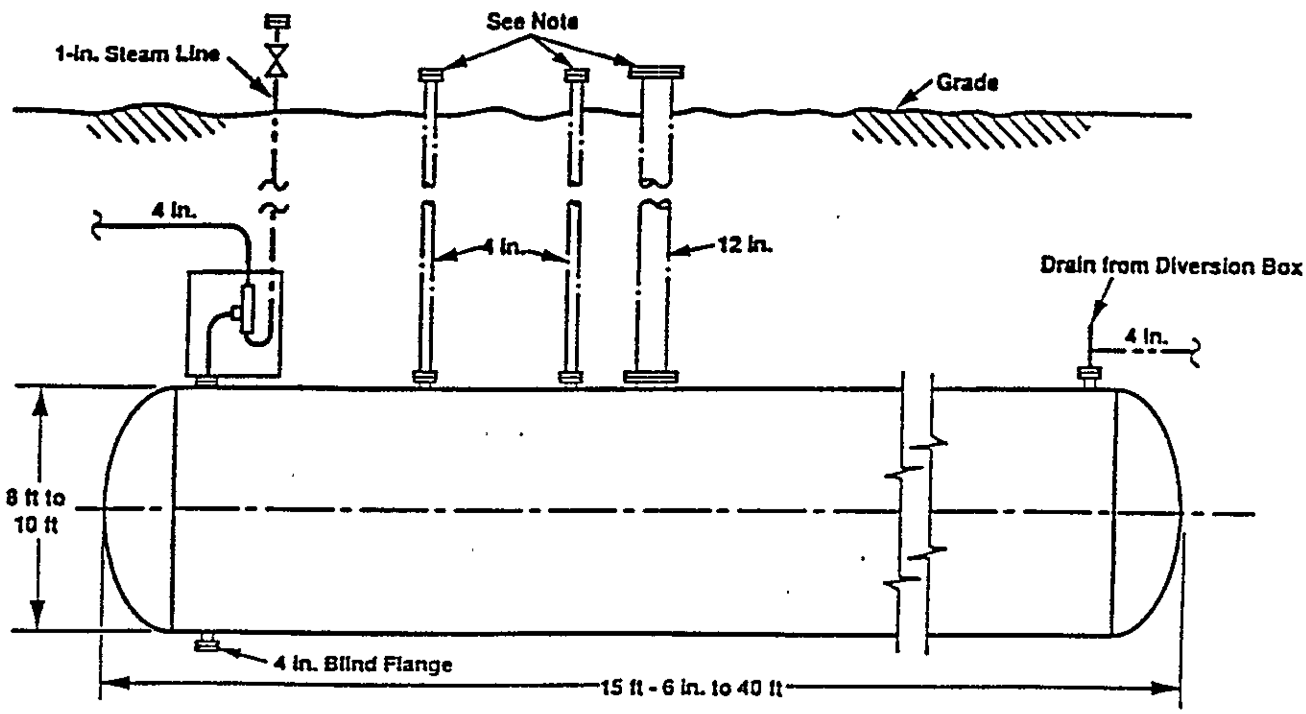
For purposes of assessing the environmental consequences associated with dispositioning of ancillary equipment as part of closure, it is assumed that the entire void volume within the ancillary equipment would be filled with grout (analogous to the grout fill alternative for tanks) and that no ancillary equipment would be excavated, packaged, or disposed of as LLW or mixed waste.

Figure 3-3. 301 Series Catch Tanks and Settling Tanks 241-B-361, 241-T-361 and 241-U-361.



Note: 4-in. central riser is not present in 301 series catch tanks

Figure 3-4. 302 Series Catch Tank.



Source: Neilsen (1992)

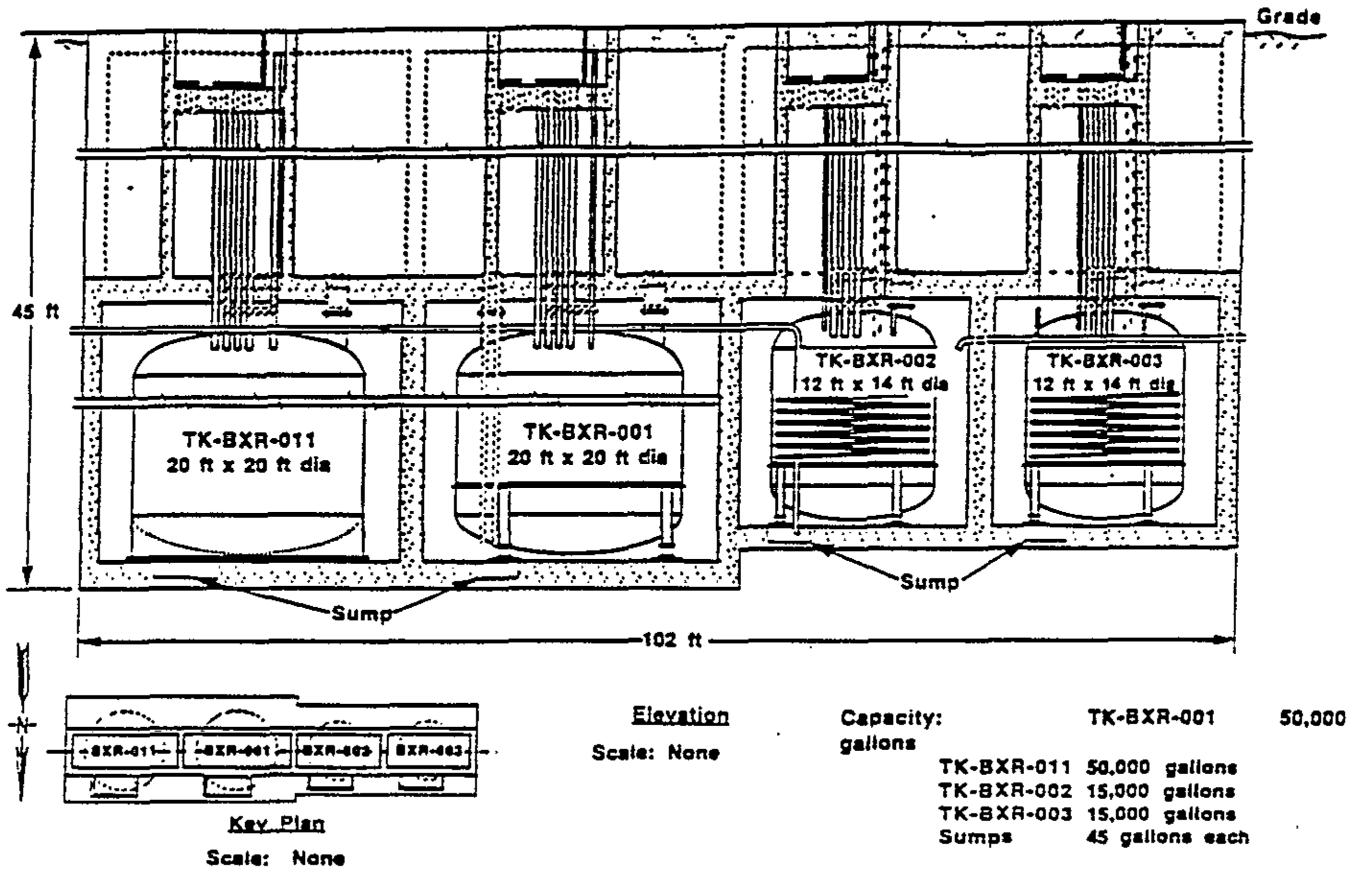
Elevation

Scale: None

Capacity Range: 7,800 - 17,680 gallons
Note: All risers sealed with gaskets.
4-in. risers for thermocouples.
12-in. risers for dip tube liquid level measurement.

39203001.1

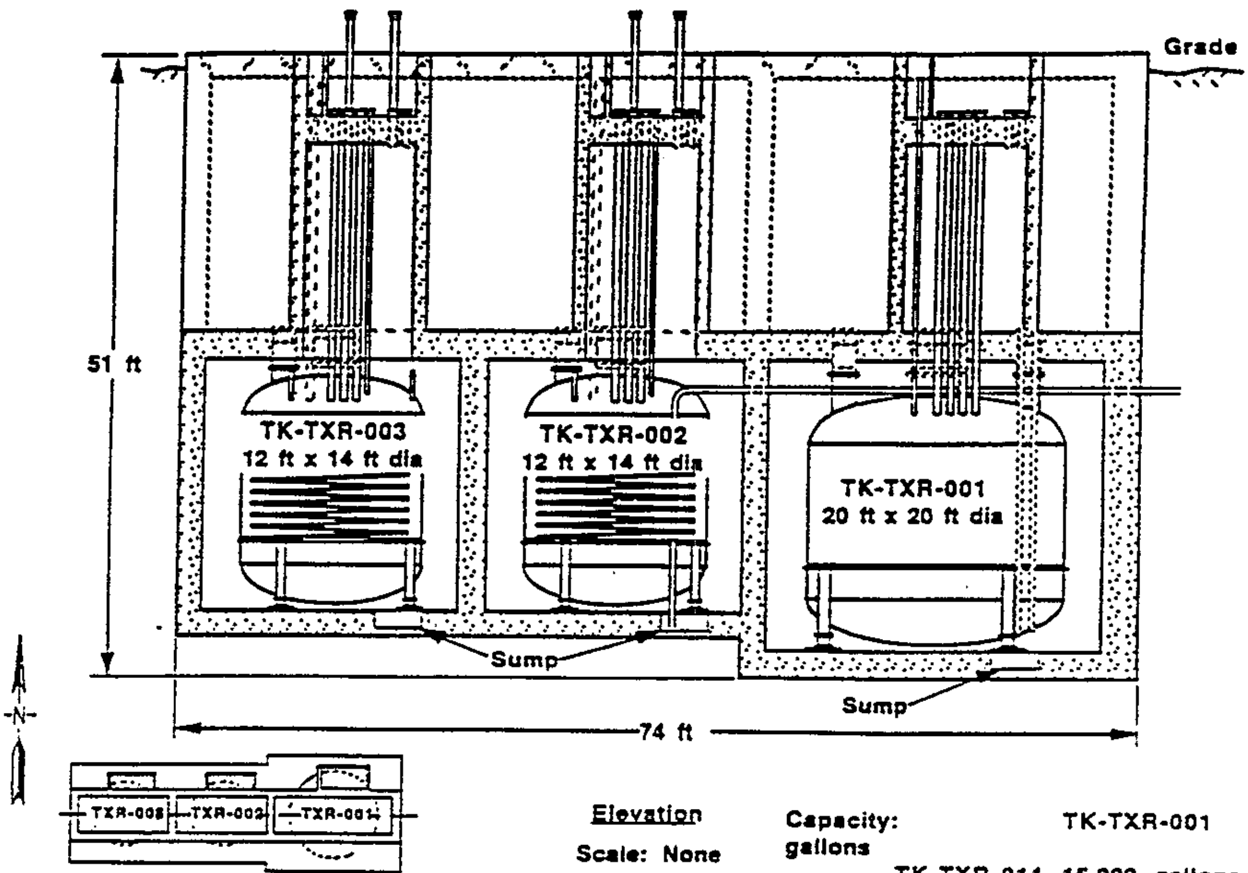
Figure 3-5. 244-BXR Vault and Tanks.



Source: Neilsen (1992) {[#3224]}

39203061.6

Figure 3-6. 244-TXR Vault and Tanks.



Key Plan

Scale: None

Elevation

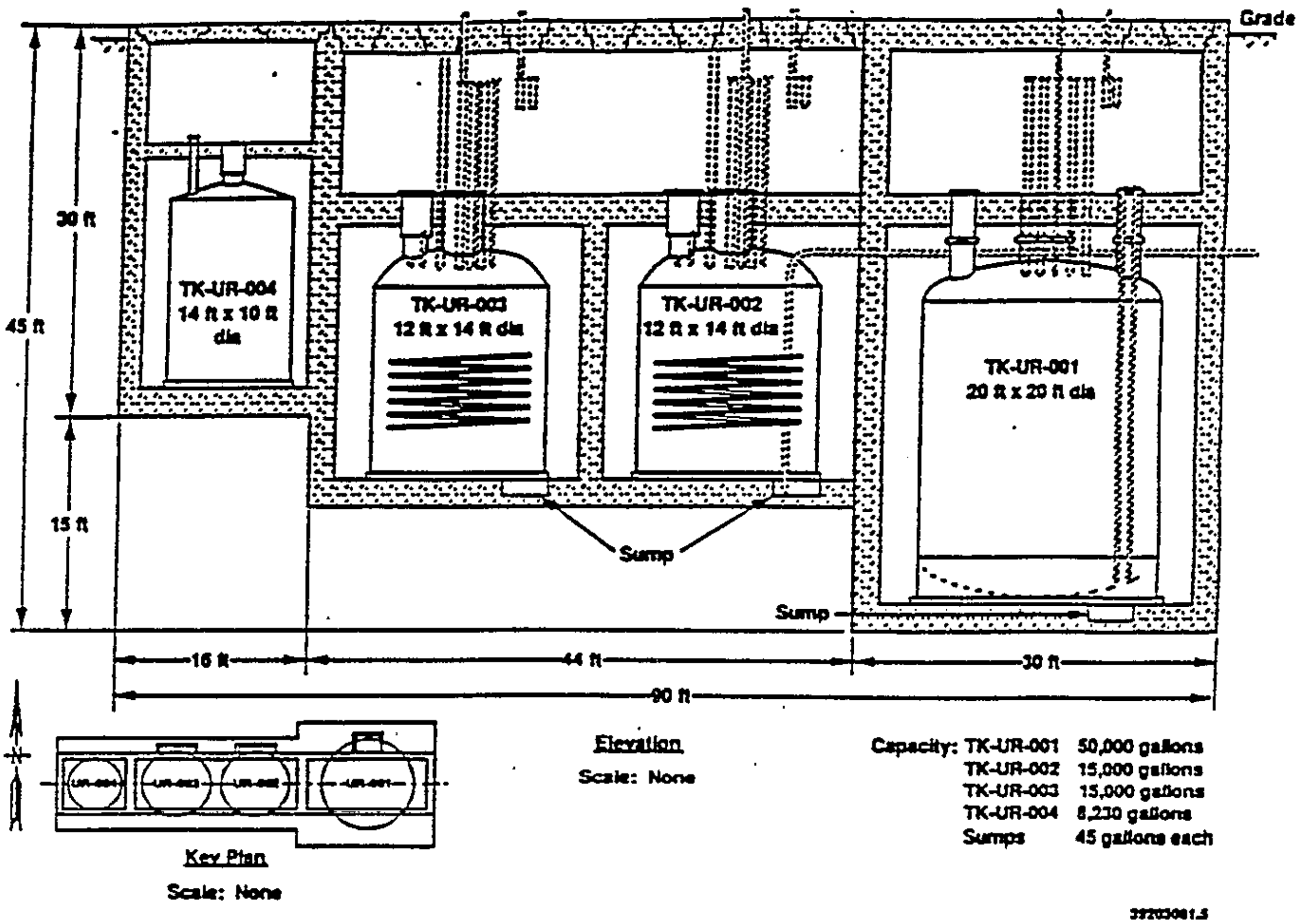
Scale: None

Capacity: TK-TXR-001 50,000 gallons
TK-TXR-011 15,000 gallons
TK-TXR-002 15,000 gallons
Sumps 45 gallons each

Source: Neilsen (1992) {[#3224]}

39203001.7

Figure 3-7. 244-UR Vault and Tanks.



3.2.2 Description of Ancillary Equipment

Ancillary equipment components are defined in the Tri-Party Agreement as *Resource Conservation and Recovery Act* (RCRA) of 1976 (RCRA 1976) past practice units. Appendix A, Table A3 provides a list of the ancillary equipment associated with SSTs (see Appendix C, the Tri-Party Agreement). In 1993, the Tri-Party Agreement signatories agreed that past practice units within tank farms boundaries (fenceline boundaries) would be closed in accordance with the *Washington Administrative Code* (WAC 173-303-610). This decision was based on the intent to establish a consistent closure approach for SSTs and associated RCRA past practice units (i.e., contiguous ancillary equipment and spill sites) to eliminate redundancies in effort, time, and expense.

RCRA past practice units associated with SSTs include piping and control elements for routing waste to a specific tank or from one tank to another. Although the specific arrangement and connections would vary in detail between the various tank farms, all tank farms would be laid out in the same basic arrangement, where one main diversion box would serve several secondary diversion boxes or valve pits which, in turn, would serve three to nine tanks.

Piping consists primarily of welded-joint schedule 40 or 80 carbon steel (a limited amount of schedule 10 was used in the earlier installations). It varied in diameter from 8 to 15 cm (3 to 6 in.). Piping is buried or is within reinforced concrete encasements underground. A limited amount of double-wall pipe (a pipe within a pipe) also was installed. All pipes received one coat of red lead paint during installation. Underground pipe also received two coats of bitumastic paint and was double-wrapped with tar paper. Many pipe runs are equipped with pressure test connections. As many as 10 percent of the pipe runs, particularly the older schedule 10 pipes, are known or suspected to have leaks. Cathodic protection has been incorporated in some piping systems during the past 10 years; the adequacy of existing cathodic protection has not been verified. Some pipelines have been abandoned in place because of plugging.

The pipe encasement system consists of a monolithic reinforced concrete trough and removable reinforced concrete cover. Encasement wall thicknesses are typically 20 to 25 cm (8 to 10 in.), and cavities are minimally-sized to accommodate the installation of piping with the cover removed. Depth of soil cover over the encasements averages 1.8 to 2.4 m (6 to 8 ft). The encasement runs are sloped at about 1 percent to provide catchment of waste leaks or seepage of surface water runoff, and low points drain to a catch tank or pump or sluice pits. With a slope of only 1 percent, it is likely that shallow ponds occur in some sections of encasement. Swab risers at the low points of the encasement are provided to facilitate contamination monitoring.

Diversion boxes are mainly two-or three-chambered underground vaults. Inlet and outlet chambers provide isolated routing space for the intricate maze of inlet and outlet pipes. Waste flow diversion takes place in the central chamber by jumpers and associated valving. Jumpers, flexible or rigid pipes from 0.02-0.1 m (1 -4 in.) in diameter, are connected to the inlet and outlet pipes at the central chamber bulkheads by dry disconnect couplings. Jumper connections are routinely reconfigured to meet specific waste routing requirements. The central chamber perimeter is equipped with interior spray nozzles to provide a remotely activated surface decontamination wash mechanism. Diversion boxes are reinforced concrete with 0.6 m (2 ft) thick walls and 0.6 (2 ft) thick removable covers at grade level. A gantry crane is deployed over the central chamber to facilitate cover removal and equipment handling. The interiors of the diversion boxes were treated with Americoat, a chemical resistant paint, during construction. In some tank farms, valve boxes were installed instead of diversion boxes, but essential design features and functions are the same.

Liquid waste from underground piping is routed to an individual tank through one or more reinforced concrete pits above the tank, except for some very old tanks with side entry connections. Within these pump and sluice pits, dry disconnect jumpers are used for piping connections to pumps, valves, standpipes, etc. Interior spray nozzles provide decontamination washing of the pits. Drainage is directly into the waste tanks.

Several buried catch tanks provide collection points for liquids draining from diversion boxes and some encasements. The tanks, which are cylindrical in shape and constructed of steel, are accessible for sampling and pumping by standpipes.

Risers are vertical pipes connecting to tank domes. They vary in diameter from 2.5 cm to 107 cm (1-42 in.). Individual single-shell tanks may have as few as 6, or as many as 38 risers. Risers provide access for certain types of tank equipment including instrumentation and pumps. Some of the risers may be modified or removed by waste retrieval operations.

In two tank farms, French drains and septic tanks have been installed to collect and disperse surface water runoff from impervious paving and pads.

3.2.3 Development of Engineering Support Data

Void volumes within the past practice units are the combined volumes of tank farm piping, risers, and pits and encasements. The estimates of ancillary void volumes for the 12 SST tank farms are based on detailed analyses of three tank complexes: 241-A, 241-T, and 241-TY. Volume estimates for other farms are based on similarity to 241-A or 241-T. Void volume data for ancillary equipment are summarized in Appendix A, Figures A9-A13 (Boomer et al. 1993).

Void volumes for ancillary equipment associated with DSTs have been estimated based on similarity to the 241-A tank complexarm. Voids were estimated based on a factor of 28/6 times the 241-A tank complex volume. There are 28 DSTs, six of which are located in the 241-A tank complex. The result of this estimation is a void piping volume of approximately 1,120 m^3 (296,000 gal) and a void structure volume of approximately 6,770 m^3 (1.8 million gal) (Boomer et al. 1993).

3.3 HANFORD BARRIER

3.3.1 Barrier Design Basis

The need for a long-term, robust surface barrier design was identified first in the *Hanford Waste Management Plan* (DOE-RL 1987) and in the *Final Environmental Impact Statement for the Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes* (DOE 1987). The Hanford Site Permanent Isolation Barrier Development Program was organized soon after these documents were published.

The Hanford Barrier is the product of extensive research and engineering by the Hanford Barrier Development Team. Since 1987, numerous design concepts have been explored and evaluated in developing the current design.

In summary, performance objectives of the barrier system include the following:

- Function in a semi-arid to sub-humid climate
- Limit the amount of water migration through the waste to near zero amounts
- Be maintenance free
- Minimize the likelihood of intrusion by plants, animals, or people
- Limit the amount of noxious gases released to the air to less than those requiring a state emissions permit
- Minimize erosion
- Meet or exceed RCRA cover performance requirements
- Isolate wastes for a minimum of one thousand years
- Be acceptable to regulators and the public.

These performance objectives have been documented in *Performance Isolation Surface Barrier: Functional Performance* (Wing 1993).

3.3.2 The Hanford Barrier

The Hanford Barrier was originally envisioned to provide long-term isolation for radiological waste sites such as tank waste residuals containing HLW, grout vaults containing high-activity LLW, and sites with transuranic contamination. As a result of evaluating barrier needs for the Environmental Restoration Program, the Hanford Barrier has also been identified as the appropriate barrier option for greater than Class C LLW and related mixed wastes.

The Hanford Barrier would be composed of 10 layers with a combined thickness of 4.5 m (14.8 ft); these layers are described in detail from the top of the barrier down. The Hanford Barrier would be placed over the top of the stabilized tanks and ancillary equipment and over the LLW vaults described in the No Separations and Tri-Party Agreement alternatives. However, barrier construction over the LLW vaults would not begin until 5 years after the construction of the vaults is completed. This would allow for the completion of a 5-year monitoring period of any leachate from the leachate collection system under the vaults. More detailed information on the design basis and specifications for the Hanford Barrier can be found in *Prototype Hanford Surface Barrier: Design Basis Document* (Myers and Duranceau 1994).

Each layer of the proposed Hanford Barrier has a specific purpose. The top vegetative cover, which would be planted in the fall,would have a very important role in water retention and removal. Five species of perennial grasses would be planted across the barrier top. Seeding would include disking the soil, applying granular fertilizer, and seeding with a perennial grass mixture. To assist the establishment of cover grass, the site would be mulched with straw that would be crimped into the soil to minimize wind erosion until cover vegetation developed.

The top barrier layer would consist of topsoil with a pea-gravel admixture; the second layer would be topsoil without pea-gravel. The first layer would be 1 m (3.3 ft) of sandy silt to silt loam soil with a 15 percent (weight) admixture of pea gravel. It would be placed loosely with a bulk density of 1.46 grams per cubic centimeter (g/cm^3) or 91 to 92 pounds per cubic foot (lb/ft^3). The second layer would have the same type of topsoil; however, the bulk density would be approximately 1.38 g/cm^3 (86 lb/ft^3). These two layers would manage water by storing precipitation and providing a media for the growth of cover vegetation as well as allowing water to be removed by evaporation and transpiration by the cover plants. The proposed topsoil barrier would be obtained from the McGee Ranch area of the Hanford Site.

The third layer would be a geotextile, used primarily to separate topsoil layers from the sand filtration layer. After construction was completed, this geotextile would no longer have a specific function; therefore, its long-term durability is not an issue. The geotextile would be trucked in from the vendor.

The fourth layer would be a sand filter, and the fifth layer would be a gravel filter. The purpose of these two layers would be to prevent migration and accumulation of fine-textured topsoil in the basalt layer. A capillary barrier, which occurs when a layer of fine-textured soil overlays a layer of coarser-textured soil (e.g., sand, gravel, or rock), would be created at the interface between the geotextile and the fourth layer (sand filter). Surface tension effects within the pore space of fine-textured soil would exerts a negative pressure on the contained soil moisture. For moisture to drain out of fine-textured soil, suction pressure would have to be overcome by the development of gravitational pressure (hydraulic head) within the layer. In effect, some portion of the full thickness of this fine-soil layer would have to become completely saturated before drainage could occur. The sand filter would be 0.15 m (0.5 ft) deep, and the gravel filter would be 0.30 m (1 ft) deep. Both layers would be obtained from a local borrow site on the 200 Area Plateau.

The sixth layer would be constructed of coarse basalt (0.05 m < size of shot rock < 0.25 m). The basalt layer would control biointrusion from plant roots, burrowing animals, and people. The basalt would act as an impediment to exploratory drilling. A subsurface layer consisting of loose fractured rock would pose a particularly adverse drilling condition for the following reasons: circulation could not be maintained, cuttings could not be adequately removed from the hole, the drill bit could not receive adequate lubrication, and firm contact could not be maintained between the bit and the rock. All these would contribute to high bit wear and minimal advance of the drill hole. This layer also would prevent moisture retention because large void spaces would enable water to drain into the seventh layer.

The seventh layer would be for lateral drainage. It would consist of screened aggregate material having a diameter of 0.001 m or greater; this would give a hydraulic conductivity of at least 1 centimeter per second (cm/sec). This layer is part of contingency planning; any water draining to the seventh layer would be collected and/or diverted to the edge of the cover because of the 2 percent slope. This layer would be approximately 4 m (13 ft) below final grade to protect against frost penetration.

The eighth layer would consist of asphalt that would serve as a low-permeability barrier and as a secondary biointrusion barrier. The asphalt would be a durable asphaltic concrete mixture consisting of double-tar asphalt with added sand as a binder material. This layer would be 0.15 m (0.5 ft) thick with a hydraulic conductivity of around 10^{-8} cm/sec. Natural analog studies estimate that this asphalt could remain functional for a period of 5,000 years or more as long as the asphalt remained covered and protected from ultraviolet radiation and freeze and thaw activity. To provide additional protection against leakage, the asphaltic concrete would be coated with a sprayed asphaltic coating material which would be puncture-resistant, flexible, and easy to apply. The asphaltic coating material would have a permeability value of about 10^{-11} cm/sec.

The ninth layer would be an asphalt base course that would provide a stable base for construction of the asphalt layer.

Finally, the tenth layer would contain grading fill that would establish a smooth, planar base surface for construction of the barrier layers. The sites covered by the Hanford Barrier would be contoured and graded for a uniform slope of 2 percent.

Figure 3-8 is a pictorial representation of the Hanford Barrier. Backup information regarding the specifications for each layer are in Appendix A. The barriers would cap groups of tanks, not individual tanks. The tank array size (tank edge-to-edge dimensions) and the corresponding barrier sizes are tabulated in Appendix A. Each barrier would include 9 m of additional coverage on each side of the barrier.

The Hanford Barrier would meet specifications for use over the SSTs, DSTs, and MUSTs that have been stabilized in situ and over LLW containing solidified or vitrified LLW.

3.3.3 Barrier Cost Estimate

3.3.3.1 Cost Estimate Categories. The cost estimate for the engineering design of the Hanford Barrier was subdivided into three categories: definitive design; construction management, engineering, and inspection; and sealed double-ring infiltrometer tests for the asphaltic concrete layer. Historical data provides the basis for the first and second categories. Actual projects were compared, and a weighted average of project costs was computed to arrive at the cost estimates presented (see Tables 5-8 through 5-10 for cost breakdowns).

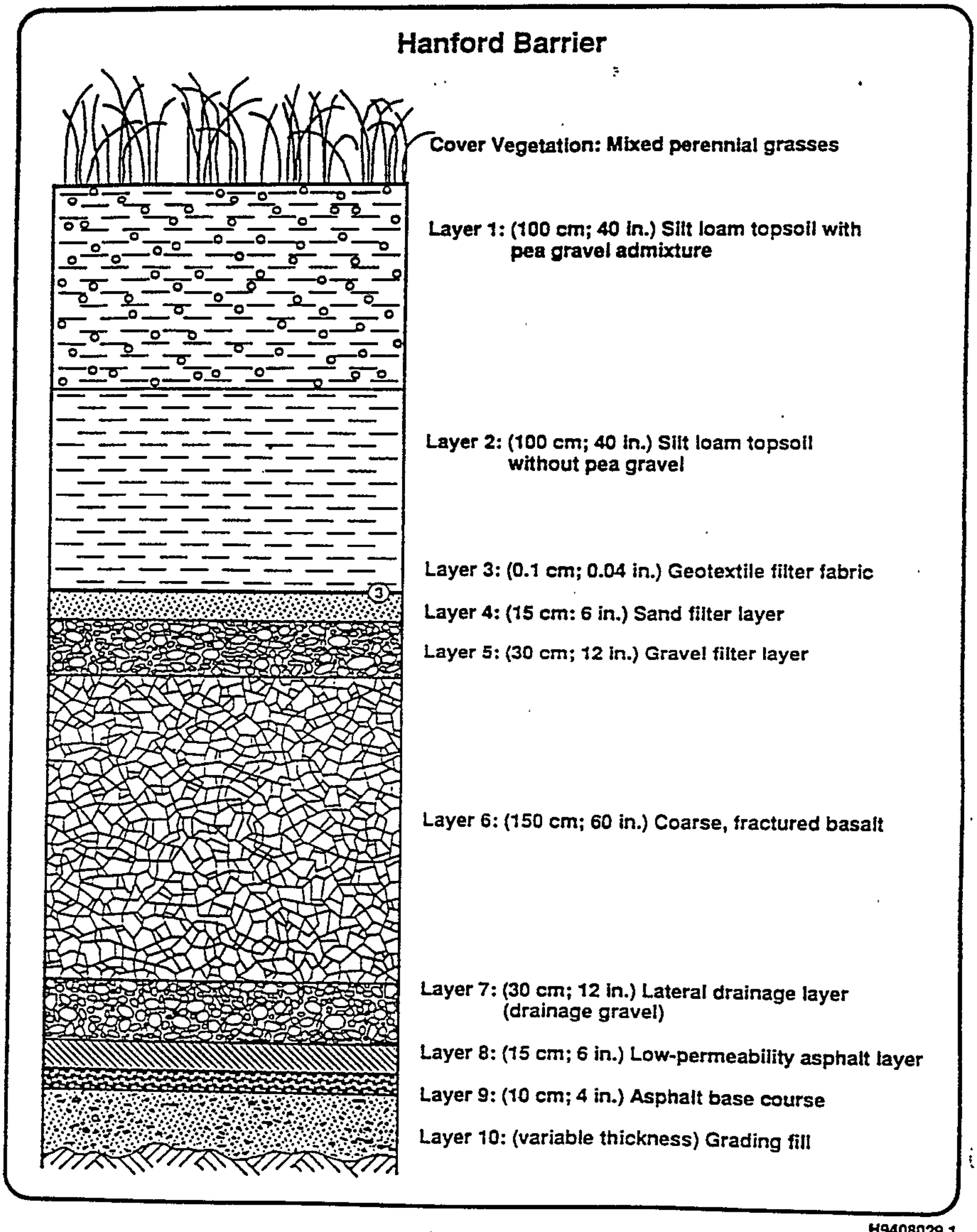
The first category, definitive design, includes the following: plan and section drawings, specifications, quality control plans for construction, materials testing, performance and stability calculations, and procurement documents. Definitive design is estimated to cost 10 percent of construction costs.

The second category, construction management, engineering, and inspection, includes the following: bid evaluations, control and review of vendor submittals, engineering support during construction, design change control, inspection planning, constructibility reviews, and production of as-built drawings. It also includes quality control overview and most sampling and testing (not including the SDRI test). Construction management, engineering and inspection is estimated to cost 10 percent of construction costs.

The third category, includes the sealed double-ring infiltrometer tests performed on the asphaltic concrete layer of the barrier. These tests, which are required by the Environmental Protection Agency, would give a direct measurement of the hydraulic conductivity of the layer and would help in determining whether the asphaltic concrete layer was properly placed. Costs include labor, equipment, per diem and travel expenses related to construction, installation, and monitoring of the test, and disassembly of the testing apparatus. Equipment costs are limited to the expendable portion of the testing apparatus. Costs for this task are estimated at $65,000 per barrier.

3.3.3.2 Cost Components. The cost components involved in the construction of the Hanford Barrier includes the following: site grading, compaction, and placement of grading fill; and placement of the asphalt base course, the asphaltic concrete layer, the gravel drainage layer, the coarse, fractured basalt layer and side slopes, the gravel and sand filter

Figure 3-8. Hanford Barrier.



layers, the lower silt layer, the upper silt layer with the pea gravel admixture, and the road base aggregate on the perimeter access road of each barrier site. These cost components are outlined below.

Site grading, compaction, and placement of grading fill are calculated using the following assumptions: the area would be devoid of vegetation so that no clearing and grubbing would be necessary, the existing site surface would be slightly irregular and slopes at approximately 1.5 percent to the north, and surface grading would be done exclusively with fill. The cost is based on a site surface measuring approximately 126 m (415 ft) in an east-west direction by 162 m (530 ft) in a north-south direction. The material used would be obtained from Pit 30, located between 200 West Area and 200 East Area and opposite the 609A fire station. Moisture conditioning (addition and control) would be performed at Pit 30 prior to transportation to the construction site. The one-way haul will be approximately 6.4 km (4 mi). Grading fill and existing site soils would be densified by making several passes over the site with a vibratory compactor to create a suitable sub-base for barrier construction.

Placement of the asphalt base course would include hauling and placing material provided by a local commercial supplier. A track dozer would spread and grade the material; a vibratory compactor would densify the base course material as it was placed. The base course material would be constructed on a 2 percent slope.

Placement of asphaltic concrete would be performed by a qualified contractor. The asphaltic concrete would consist of a double-tar asphaltic concrete mix with a spray-applied top coat of a proprietary liquid styrene-butadiene asphaltic material. The asphalt layer would be 0.15 m (0.5 ft) thick with a 2 percent slope.

Placement of the gravel drainage layer would begin by obtaining the material from Pit 30. Construction of this layer would require hauling and placing the gravel. A motor grader would spread and grade the material; a vibratory compactor would be used also.

Placement of the coarse, fractured basalt layer and side slopes would include constructing slide slopes at a 2 horizontal to 1 vertical. A 4.6 m- (15 ft-) wide perimeter access road bed would service vehicles at the crown. The maximum thickness of basalt would be beneath the access road; the coarse basalt layer would be a uniform 1.5 m (5 ft) thick. At the margin, the basalt layer would taper up to the crown on a slope of 3 horizontal to 1 vertical. The basalt would be taken from an existing quarry east of State Highway 24 on the east end of Umtanum Ridge, overlooking the Vernita Bridge. The one-way haul would be approximately 27 km (17 mi). The material density is assumed to be 0.75 m^3 per m^3 of volume with a specific gravity of 2.70 (corresponding to 126.4 lb/ft^3). Tables 5-5 and 5-6 provide additional information about the types of transportation used and load amount required for each barrier component.

Placement of the gravel and sand filter layers would prevent entry and accumulation of fines in the lateral drainage area. Filter gravel would be taken from Pit 30 and screened to specification at the pit. Construction of the gravel filter layer would require hauling and placing the gravel, which has a material density of 0.70 m^3 solids per m^3 of volume and a specific gravity of 2.70 (corresponding to 118 lb/ft^3). Filter sand also would be taken from Pit 30. This material would be another size fraction product from the same separation process that would provide the gravel filter material. Construction of the sand filter layer would require hauling and placing the material, which has a material density of 0.70 m^3 solids per m^3 volume and a specific gravity of 2.65 (corresponding to 116 lb/ft^3). A motor grader and a vibratory compactor would be required to support construction of this layer. When completed, the two filter layers would slope down at 2 percent over the central part of the cover area and up at 3:1 around the perimeter.

A non-woven, needle-punched, polypropylene geotextile would be placed over the top of the sand filter layer as a construction aid.

The lower silt layer would be obtained from the McGee Ranch site, a 27 km (17 mi) one-way haul on existing roads. A map of these roads is included in BHI-0005 (Duranceau 1995). Construction would require hauling and placing this material. Quantities were based upon the following dry unit weights: bank unit weight of 1,390 kg/m^3 (86.5 lb/ft^3), loose unit weight loaded on haul trucks of 1,160 kg/m^3 (72.1 lb/ft^3) assuming a 20 percent swell, and placement to a unit weight of 1,390 kg/m^3 (86.5 lb/ft^3). A motor grader or a small dozer would be used to spread the material. Minimal compaction of this layer would be required. Because wheel or track loads of placement equipment would provide sufficient compaction, no additional compaction equipment would be required.

The upper silt layer would be obtained from the McGee Ranch site. The material would be transported to an admix plant, located at Pit 30. Pea gravel would be mixed mechanically with silt to produce a product that would be 85 percent silt and 15 percent pea gravel (by weight). The dry unit weight of the McGee Ranch silt is 1,390 kg/m^3 (86.5 lb/ft^3); the loose unit weight of the silt would be 1,160 kg/m^3 (72.1 lb/ft^3) assuming a 20 percent swell; and the placement bank unit weight would be 1,440 kg/m^3 (90 lb/ft^3). A motor grader or a small dozer would be used to spread this layer. No additional compaction equipment would be required.

The road base aggregate for the perimeter road would be $<$ 0.038 m ($<$ 0.125 ft) in diameter. It would be provided by a local commercial supplier. Construction would require hauling and placing this aggregate, which has a material density of 0.75 m^3 solids per m^3 of volume and a specific gravity of 2.70 (corresponding to 126 lb/ft^3). A motor grader and a vibratory compactor would be used to spread, grade, and compact this material.

4.0 MONITORING AND MAINTENANCE

Monitoring and maintenance would include the following activities:

- Planting and maintaining the vegetative cover
- Cover performance monitoring, including moisture monitoring and surface elevation monitoring (for soil loss and subsidence measures)
- Inspection of covered sites for regulatory compliance purposes.

Groundwater sampling and monitoring in accordance with RCRA are not included because these costs are defrayed by other Hanford Site programs.

Cover vegetation would consist of a mixture of native perennial grass species. After disking and seeding, the site would be mulched with two tons per acre of straw, which in turn, would be crimped into the soil to resist wind erosion. Equipment would include a farm tractor with disk, seeder, mulcher, and crimper implements. Seeding and mulching would require approximately 5 staff days per hectare (2 staff days/acre), approximately $990 per hectare ($400 per acre) for equipment usage, and $5,900 per hectare ($2,400 per acre) for materials. All materials would be purchased locally. Barrier sites may need to be reseeded at intervals during the postclosure period to replace vegetation destroyed by range fires. Costs and personnel requirements include reseeding once every ten years.

Cover moisture monitoring is expected to require about 7 staff days of labor per covered site per year. Plane surveys to assess elevation control and associated analytical labor are estimated to require about 30 staff days per covered site per year. Approximately 8 additional staff days per site would be required for the following: periodic inspections of the overall physical condition of the cover, monitoring the health of cover vegetation, obtaining physical evidence of erosion or deposition of topsoil, and monitoring other physical changes (e.g., the accumulation of debris) that would require non-routine maintenance. An allowance of $800 per month was made for monitoring materials and supplies.

According to the breakdown of direct manpower requirements described above, monitoring and maintenance would require a crew of four, one supervisor, and one clerk/secretary. Monitoring and maintenance activities will continue for 100 years, the maximum span of institutional control.

Costs were identified for the following monitoring and maintenance equipment items:

- One 100-HP farm tractor with disk, rotovator/packer, and seed drill at $91,000 (estimate from R.W. Ohrt, E-062-93, ICF Kaiser Hanford);
- Three pickup trucks at $20,000 each.

These items would be replaced every five years for 100 years, the maximum span of institutional control. The item costs reflect 1994 dollars and do not include overhead costs.

5.0 TABLE DATA

The following tables clarify manpower and material requirements, costs, and schedules for tank and ancillary equipment stabilization and barrier construction. In most instances, separate tables have been constructed for these activities. However, for scheduling, one table, which covers tank stabilization, ancillary equipment stabilization, and surface barrier construction is presented because the duration of tank stabilization and ancillary equipment stabilization activities is very short compared with surface barrier construction.

The backup material used as the basis for calculations reflected in these tables is in Appendix A.

Table 5-1. Comparison of Alternatives by Unit Process: Barrier Construction Personnel Requirements (Staff Hours).

Process	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Barrier construction	449,000	154,000	951,000	449,000	145,000
Emptied SST closure	n/a	353,000	353,000	353,000	353,000
Emptied DST closure	n/a	96,000	96,000	96,000	96,000
Total	449,000	603,000	1,400,000	898,000	594,000

Notes:

SST = single-shell tank
DST = double-shell tank

The numbers include construction personnel only, and do not reflect personnel such as clerical assistant or engineering/design personnel.

For additional backup information, see Appendix A, Figures A2, A3, and A4 and Tables A8, A9, and A12.

Table 5-2A. Comparison of Alternatives by Construction Personnel Requirements for Tank Stabilization with Gravel (Staff Hours).

Construction Personnel	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Design/engineering	n/a	177,000	177,000	177,000	177,000
Construction					
Radiation worker	n/a	65,000	65,000	65,000	65,000
Nonradiation worker	n/a	29,000	29,000	29,000	29,000
Supervisory	n/a	36,000	36,000	36,000	36,000
Total		307,000	307,000	307,000	307,000

Notes:

n/a = not applicable

All staff hours, with the exception of nonradiation construction workers, are based upon the cost estimate by the Westinghouse Hanford Company for gravel fill (March 23, 1993). The cost estimate was computed for a smaller volume of gravel used; therefore, the staff hour values have been scaled to reflect the larger volume of gravel. All workers near the tanks were assumed to be radiation workers (including 1 hopper operator, 1 gravel quality control worker, and 2 belt inspectors); nonradiation workers include the quarry staff (1 loader, 1 grizzley operator, and 2 truck drivers) and one part-time clerical worker (not included in the original estimate, job number 9342GRVL). Maintenance and mechanical support are assumed to be provided by the contractor.

This table includes gravel fill for 133 single-shell tanks (SSTs) and all 28 double-shell tanks. The 16 small SSTs (55,000 gallons each) are not included in these totals as they will be filled with grout rather than gravel.

For additional backup information, see Appendix A, Figure A1 and Table A1 and A2.

Table 5-2B. Comparison of Alternatives by Construction Personnel Requirements for Tank Stabilization by Concrete (Staff Hours).

Construction Personnel	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Design/engineering	n/a	96,000	96,000	96,000	96,000
Construction					
Radiation worker	n/a	68,000	68,000	68,000	68,000
Nonradiation worker	n/a	70,000	70,000	70,000	70,000
Supervisory	n/a	34,000	34,000	34,000	34,000
Total		268,000	268,000	268,000	268,000

Notes:

n/a = not applicable

Personnel requirements are based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993). The design/engineering portion includes 1 supervisor and 9 engineers. Design will take about 5 years; most of this task can take place concurrently with treatment operations, and 80% can be finished prior to closure activities. The other 20% will be needed to address any engineering problems that may arise during the grout fill operations. Radiation workers include 1 batch plant operator, 1 mix quality control worker, and 2 hose inspectors. This crew will be maintained throughout the tank stabilization activity. However, they will be "working" only when lifts are placed; during curing periods, it is assumed that they are employed elsewhere. Nonradiation workers include quarry personnel (1 loader, 1 dry mix plant operator, and 2 drivers), and one part-time clerical worker. Maintenance and mechanical support are assumed to be provided by the contractor.

The duration of grout fill operations (Option B) was based on the assumption of a maximum depth of 0.91 (3 ft) per lift of grout, with a curing time of 7 days between lifts. Five day work weeks of 8 hours per day are assumed.

Work is assumed to be performed only when lifts are placed (not during curing times), with one lift placed per day. The total amount of lifts is 2,139 for all single-shell and double-shell tanks.

For additional backup information, see Appendix A, Figures A1 and Tables A1 and A2.

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

Table 5-2C. Comparison of Alternatives by Construction Personnel Requirements for Ancillary Equipment Stabilization by Concrete (Staff Hours).

Construction Personnel	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Design/engineering	n/a	1330	1330	1330	1330
Construction					
Radiation worker	n/a	940	940	940	940
Nonradiation worker	n/a	970	970	970	970
Supervisory	n/a	470	470	470	470
Total		3710	3710	3710	3710

Notes:

Personnel requirements are based on the ratio of the requirements in Table 2B, that is, 36 percent of personnel are involved with design/engineering, 25 percent are radiation workers, 26 percent are nonradiation workers, and 13 percent are supervisors. The actual numbers were derived from a comparison of the volume of void space to be filled in the ancillary equipment to the volume of void space to be filled in the SSTs and DSTs.

The volume of the ancillary equipment for single-shell tanks (SSTs) is in Appendix A. The ratio of these void volumes to the capacity of all SSTs (10,475 m^3)/ (364,331 m^3) = 2.88 percent. It was assumed that the ratio of the ancillary equipment for the double-shell tanks (DSTs) would be the same. Therefore, (2.88 percent)*(111,586 m^3) = 3,208 m^3. Since it takes 17.31 days to stabilize 10,475 m^3 of SST ancillary equipment, it will take 5.3 days to stabilize 3,208 m^3 of DST ancillary equipment.

For additional backup information, see Appendix A, Tables A3-A7.

Table 5-2D. Comparison of Alternatives by Barrier Construction Personnel Requirements (Staff Hours).[1,2]

Construction Personnel	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Design/engineering[3]	208,000	269,000	550,000	208,000	266,000
Construction[4,5]					
Radiation worker	364,000	496,000	1,180,000	364,000	488,000
Nonradiation worker	0	0	0	0	0
Supervisory	65,000	87,000	203,000	65,000	86,000
Total	637,000	852,000	1,930,000	637,000	840,000

Notes:

[1]The Hanford Barrier budget estimate for a 6-acre barrier, completed by R. W. Ohrt (E-062-93), was used to compute the manhour requirements.

[2]Average wage for an exempt employee at TWRS is $57.11/hour, for a non-exempt employee is $22.35/hour, and for a bargaining unit employee is $41.31/hour (based on overhead, the common support pool and general and administrative rates found in Soft Reporting on November 11, 1994 for organization code 70000).

[3]For design/engineering personnel, an hourly rate of $85 was assumed, per cc: Mail message from T. L. Waldo to Pat Scanlon. The engineering subtotal for each barrier was divided by this hourly rate to obtain engineering manhours.

[4]For each component of the barrier (excepting the asphaltic concrete), a ratio of the quantity of material necessary for barrier construction to the quantity of manhours required for this construction was used for estimating. This ratio was multiplied by the quantities of construction material used to cover both the underground tanks and the low-level waste burial vaults; the result was the staff hours required for constructing each component of the barrier. Based on verbal information from Mark Buckmaster regarding construction of a similar barrier over 216-B-57 crib, it was estimated that a crew of 14 would be used for constructing each layer (2 supervisors and 12 construction workers).

[5]For the asphaltic concrete layer, it was estimated that a crew of 6 would construct this layer of a 5-acre barrier in 5 days; it was also assumed that a crew of 4 would apply the surface coating to this asphaltic concrete layer in 25 days.

For additional backup information, see Appendix A, Figures A2, A3, and A4 and Tables A8, A9, and A12.

Table 5-3A. Comparison of Alternatives by Tank Stabilization Construction Resource Requirements (Units as Indicated).

Construction Resource	In Situ Disposal[1]	Tank Stabilization by Grout	Tank Stabilization by Gravel	Ancillary Equipment Stabilization
Land (ha) surface committed[2]				
Temporarily	n/a			
Permanently	n/a			
Water (m^3) [3]	n/a	113,000	n/a	3,300
Source of water				
Energy				
Electrical (GWh) [4]	n/a	n/a	n/a	n/a
Propane (m^3)	n/a	n/a	n/a	n/a
Diesel fuel (m^3) [5]	n/a	27,900	6,380	802
Gasoline (m^3) [6]	n/a	40.1	40.1	1.2
Materials				
Concrete fill (m^3)	n/a	760,000	5,300	13,700
Steel (t)	n/a	0	n/a	0
Asphalt (m^3)	n/a	0	n/a	0
Excavation (m^3) [7]	n/a	0	n/a	0
Soil (m^3) [8]	n/a	0	n/a	0
Riprap (m^3) [9]	n/a	0	n/a	0
Gravel/concrete fill (m^3) [10]	n/a	0	754,000	0
Waste debris	n/a	30	30	
Waste water	n/a	0	0	
Sewage	n/a	0	0	

Table 5-3A. Comparison of Alternatives by Tank Stabilization Construction Resource Requirements (Units as Indicated).

Notes:

ha = hectares
n/a = not applicable
m^3 = cubic meters
GWh = gigawatt hour
t = metric ton

[1]All in situ disposal construction resources are documented in the in situ disposal data package and have not been addressed again in this table.

[2]Land: Permanently committed land is the sum of the barrier areas. The amount of temporarily committed land is used for equipment and materials laydown yards, and was estimated by W. A. Skelly from best engineering judgement. Both of these areas have been expressed in Table 5-3B (Barrier Construction Resource Requirements), and are not repeated here.

[3]Water: The maximum water requirement was assumed to be 50 gallons/yd^2 for barrier construction. The water requirement per barrier is the product of this maximum and the barrier acreage.

[4]Additional major power lines are not required for any of the options.

[5]Diesel fuel: See Appendix A for fuel consumption per day for specified equipment items. This number does not include fuel to run the generator that powers the high efficiency particulate air filter, or fuel to deliver gravel to the site. It only includes the fuel to run one 480 volt, 30 amp generator for the gravel slinger.

[6]Gasoline: Assume 3 light-duty trucks will be used for each barrier; each truck runs 80 miles per day and has an efficiency of 14 miles per gallon. See Tables 5-11 and 5-12 for estimates of barrier schedules; the length of each job was used to calculate the total fuel consumption per barrier.

[7]Excavation: Assumed excavation excludes the removal of material from borrow sites.

[8]Soil: Assumed that soil consists of the upper and lower silt layers of the barrier (layers 1 and 2).

[9]Riprap: Assumed that riprap refers to the basalt layer of the barrier.

[10]Gravel/sand: Assumed this figure is a compilation of all screened aggregate products from Pit 30, including the asphalt base course, the drainage media, and the gravel and sand filter layers of the barrier, as well as the road base.

For additional backup information, see Appendix A, Tables A1-A8.

Table 5-3B. Comparison of Alternatives by Barrier Construction Resource Requirements (Units as Indicated).

Construction Resource	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Land (ha) surface committed[1]					
Temporarily	20	24	24	20	24
Permanently	17	25	64	17	25
Water (m^3) [2]	38,000	57,000	145,000	38,000	57,000
Source of water					
Energy					
Electrical (GWh) [3]	n/a	n/a	n/a	n/a	n/a
Propane (m^3)	n/a	n/a	n/a	n/a	n/a
Diesel fuel (m^3) [4]	45,000	60,000	142,000	45,000	59,000
Gasoline (m^3) [5]	260	350	830	260	350
Materials					
Concrete (m^3)	0	0	0	0	0
Steel (t)	0	0	0	0	0
Asphalt (m^3)	62,500	81,600	164,000	62,500	80,700
Excavation (m^3) [6]	0	0	0	0	0
Soil (m^3) [7]	377,000	535,000	1,320,000	377,000	526,000
Riprap (m^3) [8]	638,000	809,000	1,480,000	638,000	801,000
Gravel/sand (m^3) [9]	415,000	615,000	2,250,000	415,000	598,000
Waste debris	0	0	0	0	0
Waste water	0	0	0	0	0
Sewage	0	0	0	0	0

Table 5-3B. Comparison of Alternatives by Barrier Construction Resource Requirements (Units as Indicated).

Notes:

ha = hectares
m^3 = cubic meters
n/a = not applicable
GWh = gigawatt hour
t = metric ton

[1]Land: Permanently committed land is the sum of the barrier areas. The amount of temporarily committed land is used for equipment and materials laydown yards and was estimated by W.A. Skelly.

[2]Water: The maximum water requirement was assumed to be 50 gallons per square yard for barrier construction. The water requirement per barrier is the product of this maximum and the barrier acreage.

[3]Additional major power lines are not required for any of the options.

[4]Diesel fuel: See Appendix A for fuel consumption per day for specified equipment items.

[5]Gasoline: Assume 3 light-duty trucks will be used for each barrier; each truck runs 80 miles per day and has an efficiency of 14 miles per gallon. See Tables 5-11 and 5-12 for estimates of barrier schedules. The length of each job was used to calculate the total fuel consumption per barrier.

[6]Excavation: Excludes excavation of material at borrow sites.

[7]Soil: Assumed that soil consists of the upper and lower silt layers of the barrier (layers 1 and 2).

[8]Riprap: Assumed that riprap refers to the basalt layer of the barrier (layer 6).

[9]Gravel/sand: Assumed this figure is a compilation of all screened aggregate products from Pit 30, including the asphalt base course, the drainage media, and the gravel and sand filter layers of the barrier, as well as the road base.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8 and A9.

Table 5-4. Comparison of Alternatives by Non-radiological Barrier Construction Emissions (Units as Indicated).

Construction Emission Pollutant	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Particulates (kg)	156,000	209,000	486,000	156,000	206,000
SO_x (as SO_2) (kg)	276,000	369,000	859,000	276,000	364,000
CO (kg)	1,110,000	1.480,000	3,430,000	1,110,000	1,460,000
Hydrocarbons (exhaust & fugitive) (kg)	119,000	159,000	369,000	119,000	157,000
NO_x (as NO_2) (kg)	2,540,000	3,400,000	7,920,000	2,540,000	3,360,000
Aldehydes (as HCHO) (kg)	68,000	91,100	212,000	68,000	89,800
Organic acids (kg)	n/a	n/a	n/a	n/a	n/a
Thermal releases (J)	930,000,000	621,000,000	185,000,000	930,000,000	638,000,000
Fugitive dust (t)	3,095	4,114	9,079	3,095	4,090

Note:

kg = kilograms
n/a = not applicable
J = joules
t = metric ton

See Appendix A (Dozer Grading Emissions, Paved Road Traffic Particulate Emissions, Unpaved Road Traffic Particulate Emissions, Fugitive Dust Emissions for Material Transfer, and Clearing and Grubbing Emissions) for construction emission calculations. These emissions come from the equipment used to excavate the material, to fill the tanks, and to build the barrier, as seen on page A-27.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8, A9, and A10.

Table 5-5. Comparison of Alternatives by Transportation of Earthen Borrow Barrier Construction Material (Units as Indicated).[1]

Item	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Borrow source location (state)[2]	3 km NW of site	3 km NW of site	3 km NW of site	3 km NW of site	3 km NW of site
Route location state mileage	Rt 3 to Rt 4 (7 km)	Rt 3 to Rt 4 (7 km)	Rt 3 to Rt 4 (7 km)	Rt 3 to Rt 4 (7 km)	Rt 3 to Rt 4 (7 km)
Road type gravel or asphalt	6 km paved; 1 km level gravel	6 km paved; 1 km level gravel	6 km paved; 1 km level gravel	6 km paved; 1 km level gravel	6 km paved; 1 km level gravel
Total number of trips (average/peak)					
Truck[3]	53,700	79,800	293,000	53,700	77,600
Train	0	0	0	0	0
Barge	0	0	0	0	0
New road construction (km)					
Load volumes (m^3)	7.6	7.6	7.6	7.6	7.6

Notes:

km = kilometer

[1]Borrow materials include grading fill, base course, drainage gravel, and filter material.

[2]The borrow source location is Pit 30 between 200 West and 200 East. The mileage is round-trip.

[3]The truck loads were determined by adding the amounts of excavation and gravel/sand materials and dividing this subtotal by the load volumes. These numbers were generated in Appendix A, Paved Road Traffic Particulate Emissions.

For additional backup information, see Appendix A, Figure A2, A3, and A4 and Tables A8 and A9.

Table 5-6. Comparison of Alternatives by Transportation of Other Barrier Construction Material (Units as Indicated).[1]

Item	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Borrow source location (state)	Seattle, WA	Seattle, WA	Seattle, WA	Seattle, WA	Seattle, WA
Route location state mileage[2]	240	240	240	240	240
Road type gravel or asphalt	asphalt	asphalt	asphalt	asphalt	asphalt
Total number of trips					
Truck[3]	2 (geotextile)	2 (geotextile)	2 (geotextile)	2 (geotextile)	2 (geotextile)
Train[4]	495 cars (asphalt)	646 cars (asphalt)	1,300 cars asphalt)	495 cars (asphalt)	639 cars (asphalt)
Barge	0	0	0	0	0

Note:

[1]Other barrier construction material includes the asphaltic concrete and coating and the geotextile fabric used as a construction aid.

[2]The mileage is one-way.

[3]Two truck trips assumes that each truck can carry one-half of the geotextile needed in rolls approximately 78.7 centimeters in diameter (31 inches in diameter). Each roll, an average of 4.6 meters wide and 229 meters long, will weigh on average 248 kilogram per roll. If a truck can haul 36,300 kilograms per load, a truck can carry about 146 rolls/trip.

[4]The number of train trips assumes that asphalt has a density of 721 kilograms per cubic meter, and that each railcar can carry 91,000 kilograms of asphalt.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8 and A9.

Table 5-7. Comparison of Alternatives by Monitoring and Maintenance Personnel Requirements (Staff Hours Per Year).

Operating Personnel	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Non-exempt					
Radiation worker	10,500	11,000	11,000	10,500	11,000
Nonradiation worker	0	0	0	0	0
Exempt					
Radiation worker	0	0	0	0	0
Nonradiation worker	0	0	0	0	0
Total staff hours per year	10,500	11,000	11,000	10,500	11,000

Notes:

For each alternative, this estimate includes one supervisor, 3 or 4 workers, and one clerk/secretary.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8 and A9.

Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Process Module	In Situ Disposal	Extensive Pretreatment Option A Grout/gravel	Extensive Pretreatment Option B Grout/gravel	No Separations Grout/gravel	Tri-Party Agreement Preferred Alternative Grout/gravel
Barrier construction[5]	$86	$113	$237	$86	$111
Emptied SST closure[6]	n/a	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6
Emptied DST closure[7]	n/a	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6
Total	$86	$144/$130	$268/$254	$117/$103	$142/$128

Notes:

SST = single-shell tank
DST = double-shell tank

[1]The cost of gravel was estimated from Appendix A, Cost Barrier Materials and was figured at $22 per cubic meter ($m^3$) for 756,000 m^3 of material, or $16,600,000. There are 16 55,000-gallon tanks that would be stabilized with the same grout mixture used for stabilizing the ancillary equipment. These tanks have a total void volume of 5,324 m^3. The cost of this grout was estimated at $0.14 per kilogram (kg) for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 106,500 kg of cement, the cost would be $14,900; 958,000 kg of fly ash would cost $38,300; and 5,160,000 kg of sand (3,225 m^3 of sand) would cost $59,700. The total cost of this grout is $112,900. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[2]The cost of concrete was estimated at $0.14/kg for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 15,000,000 kg of cement, the cost would be $2,100,000; 137,000,000 kg of fly ash would cost $5,480,000; 1,260,000,000 kg of sand (1,300,000 m^3 of sand) would cost $23,200,000. The total cost of this grout is $30,780,000. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[3]The cost of solidifying the ancillary equipment is based on the same grout formula as in notes 1 and 2. There is 13,700 m^3 of void space in the ancillary equipment for the SSTs and the DSTs. The SST ancillary equipment void space is 10,500 m^3, and the DST ancillary equipment void space is 3,200 m^3. For SST ancillary equipment, 210,000 kg of cement would cost $29,400; 1,890,000 kg of fly ash would cost $75,600; 17,400,000 kg of sand (10,900 m^3 of sand) would cost $201,500. The total cost of stabilizing the ancillary SST equipment would be $306,500. For DST ancillary equipment, 64,000 kg of cement would cost $8,960; 576,000 kg of fly ash would cost $23,000; 5,312,000 kg of sand (3,320 m^3 of sand) would cost $61,400. The total cost of stabilizing the ancillary DST equipment is $93,360. The cost of water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[4]The costs for monitoring and maintenance are reflected in Table 5-10 and were not included in these costs.

Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Notes: (Continued)

[5]Barrier construction includes the cost of the barrier over SSTs, DSTs, and the low-level waste vaults (where applicable).

[6]Emptied SST closure includes filling the SSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. It is assumed that the construction equipment and light-duty trucks are already available onsite and need not be purchased.

[7]Emptied DST closure includes filling the DSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. The cost of the grout plant and dry mix plant are unknown but were estimated at $250,000. It is assumed that construction equipment and light-duty trucks are already available onsite and need not be purchased.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3-A9 and A11.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Capital Cost Component	In Situ Disposal	Extensive Pretreatment Option A Grout/gravel	Extensive Pretreatment Option B Grout/gravel	No Separations Grout/gravel	Tri-Party Agreement Preferred Alternative Grout/gravel
Labor[1]	$30.6	$54.1/$57.1	$105/$107.3	$43.9/$46.9	$53.6/$56.6
Materials/supplies[2]	$28.5	$42.9/$37.4	$81.1/$75.6	$34.1/$28.6	$42.5/$37.0
Equipment[3]	n/a	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35
Local purchases[4]	$57.5	$43.5/$35.1	$130/$121	$82.9/$74.5	$42.5/$34.1
Total	$117	$141/$130	$316/$304	$161/$150	$139/$128

Notes:

n/a = not applicable

[1]Average wage for an exempt employee at TWRS is $57.11/hour, for a non-exempt employee is $22.35/hour, and for a bargaining unit employee is $41.31/hour (based on overhead, the common support pool and general and administrative rates found in Soft Reporting on November 11, 1994 for organization code 70000). Labor costs were calculated taking the staff hours from Tables 5-2A through 5-2D and multiplying by the average wage. Ancillary equipment stabilization and barrier construction labor costs were included in both grout and gravel stabilization. It was assumed that all design, engineering, and supervisory personnel were exempt, and that all radiation and nonradiation workers were bargaining unit employees.

[2]Materials and supplies include the tank and ancillary equipment stabilization materials and the materials used in barrier construction over the tanks and over the LLW Vaults (in the Extensive Pretreatment and TPA Preferred Alternatives). They include only materials that cannot be bought locally (asphalt, asphalt coating and geotextile fabric for the barrier; fly ash for the grout mix). All other materials for stabilization and barrier construction are listed in local purchases. These numbers were calculated from Appendix A, Barrier Cost by Component. Asphalt would cost $27,800,000 for tank barriers, $45,300,000 for extensive pretreatment grout, $8,500,000 for extensive pretreatment glass, and $8,100,000 for the Tri-Party Agreement glass. Geotextiles would cost $717,000 for tank barriers, $1,700,000 for extensive pretreatment grout, $284,000 for extensive pretreatment glass, and $268,000 for Tri-Party Alternative glass. Fly ash would cost $5,600,000 for the grout stabilization option (both for tanks and ancillary equipment); it would cost $137,000 for the gravel stabilization option (for the 55,000-gallon tanks and for ancillary equipment). The cost of the grout option is listed first, and the cost of the gravel option is listed second.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Notes (continued)

[3]Equipment is the cost of the dry mix plant and the concrete batch plant for the grout stabilization option, and the cost of the concrete batch plant, the dry mix plant, and the gravel slinger for the gravel stabilization option. The dry mix plant and the concrete batch plant are assumed to cost $250,000, and the gravel slinger is assumed to cost $100,000. All other heavy construction equipment and light-duty vehicles are assumed to be already onsite and do not have to be purchased.

[4]Local purchases include the Type I/II cement, the sand, and the gravel used in tank and ancillary equipment stabilization, and all barrier materials (with the exceptions of asphalt, asphalt coating, and the geotextile fabric–these costs are reflected in materials/supplies). Local purchases of material for tank barriers include $57,500,000 for barrier material; for grout stabilization, the cost is $25,400,000, and for gravel stabilization, the cost is $17,000,000. The cost of the grout stabilization is listed first; gravel stabilization is second.

For more backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3-A9 and A11.

Table 5-10. Comparison of Alternatives by Monitoring and Maintenance Cost Component (Millions of 1995 Dollars).[1,2]

Monitoring and Maintenance Cost Component	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Labor[3]	0.39	0.40	0.40	0.39	0.40
Materials/supplies[4]	0.011	0.012	0.016	0.011	0.012
Equipment[3,5]	0.030	0.030	0.030	0.030	0.030
Local purchases[4]					
Total	0.43	0.44	0.45	0.43	0.44

Notes:

[1]See Appendix A for details on the calculations.

[2]Monitoring and maintenance applies to all phases of the closure package (tank stabilization, ancillary equipment stabilization, and barrier construction).

[3]The labor rates are based on an average wage of $130,000 per year for supervisors, and $60,000 per year for laborers and a clerk/secretary.

[4]All materials and supplies are local purchases.

[5]Equipment costs are based on one tractor with attachments and three pickup trucks, to be replaced once every five years.

- For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8 and A9.

Table 5-11. Comparison of Alternatives by Overall Schedule (Calendar Year Start/Completion Date).[1]

Activity	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Construction[2]	2013,2016/ 2030, 2033	2010/2060	2010/2030	2010/2024	2010/2034
Monitoring and maintenance[3]	2015/2133	2012/2160	2012/2130	2012/2124	2012/2134
Research and development[4]					

Notes:

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The construction schedule is taken from Table 5-12 and assumes construction includes stabilization activities and barrier construction.

[3]Monitoring and maintenance scheduling assumes 100 years of operational control after the last barrier has been built.

[4]Because the stabilization methods and the barrier have been performed in engineering-scale demonstrations, the amount of research and development necessary would be negligible.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A1-A9.

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

Table 5-12. Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).[1]

Unit Process	In Situ Disposal[2] Chemical, Vitrification	Extensive Pretreatment Option A[3]	Extensive Pretreatment Option B[3]	No Separations	Tri-Party Agreement Preferred Alternative
Barrier construction	2013,2016/ 2030,2033	2024/2060	2024/2030	n/a	2028/2034
Emptied SST closure[4]	n/a	2010/2024	2010/2024	2010/2024	2010/2024
Emptied DST closure[5]	n/a	2019/2023	2019/2023	2018/2022	2023/2027

Notes:

n/a = not applicable
SST = single-shell tank
DST = double-shell tank

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The start/completion dates for barrier construction for the in-situ disposal alternative is based on WHC-SD-WM-EV-101 (McConville 1995). In situ chemical stabilization decontamination and decommissioning ends in 2013, and barrier construction over the tanks begins immediately after that task; it ends in 2030. In situ vitrification decontamination and decommissioning ends in 2016, and barrier construction over the tanks begins immediately after that task. It ends in 2033.

[3]The start and completion dates for barrier construction for the extensive pretreatment alternatives and the Tri-Party Agreement preferred alternative are based upon the assumption that no barrier construction over the low-level waste vaults can begin until decontamination and decommissioning activities for the facilities end.

[4]The start and completion dates for emptied SST closure are based on the Tank Farm Retrieval Sequence schedule found in WHC-SD-WM-ER-193. This schedule is reproduced in Appendix A. These figures reflect work occurring sequentially (that is, no parallel operations were used). Tank stabilization and ancillary equipment stabilization begin as soon as Tank Farm retrieval operations end; barrier construction begins as soon as tanks and ancillary equipment are stabilized.

[5]The start and completion dates for emptied DST closure are based upon the assumption that no tank or ancillary equipment stabilization can begin until treatment operations end, and no barrier construction can begin until tanks and ancillary equipment have been stabilized for each tank cluster. This assumption was used because no schedule was generated for the retrieval sequence of the DSTs. These figures reflect work occurring sequentially (that is, no parallel operations were used).

For additional backup information, see Appendix A, Tables A1-A9 and A-11.

Table 5-12. Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).[1]

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

McConville, C.M., 1995, *Tank Waste Remediation System Environmental Impact Statement for In Situ Treatment and Disposal of Radioactive Waste in Hanford Site Underground Storage Tanks*, WHC-SD-WM-EV-101, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 5-13. Comparison of Alternatives by Barrier Construction Equipment Schedule (Calendar Year: Start/Completion Date).[1]

Construction Equipment Type	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Heavy-duty diesel equipment	2013,2016/ 2030,2033	2010/2030	2010/2060	n/a	2010/2034
Light-duty gasoline vehicles	2013,2016/ 2030,2033	2010/2030	2010/2060	2010/2024	2010/2034
Construction noise (dB)[2]	115	115	115	115	115

Notes:

n/a = not applicable
dB = decibels

[1]This schedule is the same as the entire schedule found in Table 5-12, because the heavy-duty diesel equipment and the light-duty gasoline vehicles will be used throughout the life of the closure activities.

[2]The construction noise reflected in this table is the maximum permissible by Federal law, and is on average what a compactor or a scraper-loader produce (DOE-RL 1987).

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8, A9, and A11.

This page intentionally left blank.

6.0 REFERENCES

Boomer, K. D., S. K. Baker, A. L. Boldt, M. D. Britton, L. E. Engelsman, J. D. Galbraith, J. S. Garfield, K. A. Giese, C. E. Golberg, B. A. Higley, K. J. Hull, L. J. Johnson, R. P. Knight, J. S. Layman, R. S. Marusich, R. J. Parazin, M. G. Piepho, E. J. Slaathaug, T. L. Waldo, C. E. Worcester, 1991, *Systems Engineering Study for the Closure of Single-Shell Tanks*, WHC-EP-0405, Rev. A2, Westinghouse Hanford Company, Richland, Washington.

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Colby, S. A., 1995, *No Separations Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-103, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE, 1987, *Environmental Impact Statement for Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes*, DOE/EIS-0113, Westinghouse Hanford Company, Richland, Washington.

DOE, 1988, "Record of Decision (ROD) for Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes," *Federal Register*, Vol. 53, No. 72, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1987, *Hanford Waste Management Plan*, DOE-RL 87-13, U.S. Department of Energy-Richland Operations, Richland, Washington.

DOE-RL, 1994a, *Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas*, DOE/RL-93-33, U.S. Department of Energy, Richland Operations, Richland, Washington.

DOE-RL, 1994b, *Implementation Plan for the Tank Waste Remediation System Environmental Impact Statement*, DOE/RL-94-88, U.S. Department of Energy-Richland Operations, Richland, Washington.

Duranceau, D. A., 1995, *Site Evaluation Report for Candidate Basalt Quarry Sites*, Bechtel Hanford, Inc., Richland, Washington.

Ecology, EPA and DOE, 1994, Hanford Federal Facility Agreement and Consent Order, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1993, *Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites*, EPA 451/R-93-004, U.S. Environmental Protection Agency, Washington, D.C.

Freeman-Pollard, J. R., 1994, *Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site, Washington*, WHC-SD-EN-ES-040, Rev. 0., Westinghouse Hanford Company, Richland, Washington.

Jansen, G., Jr., 1994, *Extensive Separations Alternative Data Package for the Preparation of the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-100, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

McConville, C. M., 1995, *Tank Waste Remediation System Environmental Impact Statement for In Situ Treatment and Disposal of Radioactive Waste in Hanford Site Underground Storage Tanks*, WHC-SD-WM-EV-101, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Meng, C., 1995, *No Disposal Action Alternative for Remediating Tank Waste and Cesium and Strontium Capsules*, WHC-SD-WM-EV-099, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Myers, D. R. and D. A. Duranceau, 1994, *Prototype Hanford Surface Barrier: Design Basis Document*, BHI-00007, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Neilsen, E. H. 1992, *Miscellaneous Underground Radioactive Waste Tanks*, WHC-EP-0560, Rev. 0, Westinghouse Hanford Company, Richland, Washington,

RCRA, 1976, *Resource Conservation and Recovery Act of 1976*, as amended, Public Law 940580, 42 USC 6901 et seq.

RHO, 1983, *Tank Mock-Up Engineering Study*, SD-WM-ES-020, Rockwell Hanford Operations, Richland, Washington.

Rymarz, P. B. and D. R. Speer, 1991, *Summary of Radioactive Underground Tanks Managed by Hanford Restoration Operations*, WHC-SD-DD-TK-057, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Slaathaug, E. J., 1995, *Tri-Party Agreement Alternative Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-104, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WAC 173-303-610, 1993, "Closure and Post Closure, Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

Wing, N. R., 1993, *Performance Isolation Surface Barrier: Functional Performance*, WHC-EP-650, Westinghouse Hanford Company, Richland, Washington.

Wittreich, S. D. 1990, *Non Radioactive Dangerous Waste Landfill Closure Postclosure Plan*, DOE/RL 90-0017, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

APPENDIX A

BACKUP FIGURES AND TABLES FOR DATA TABLES

This page intentionally left blank.

Figure A1. Typical Tank Configuration (3 sheets).
(Backup to Tables 5-2A and 5-2B).

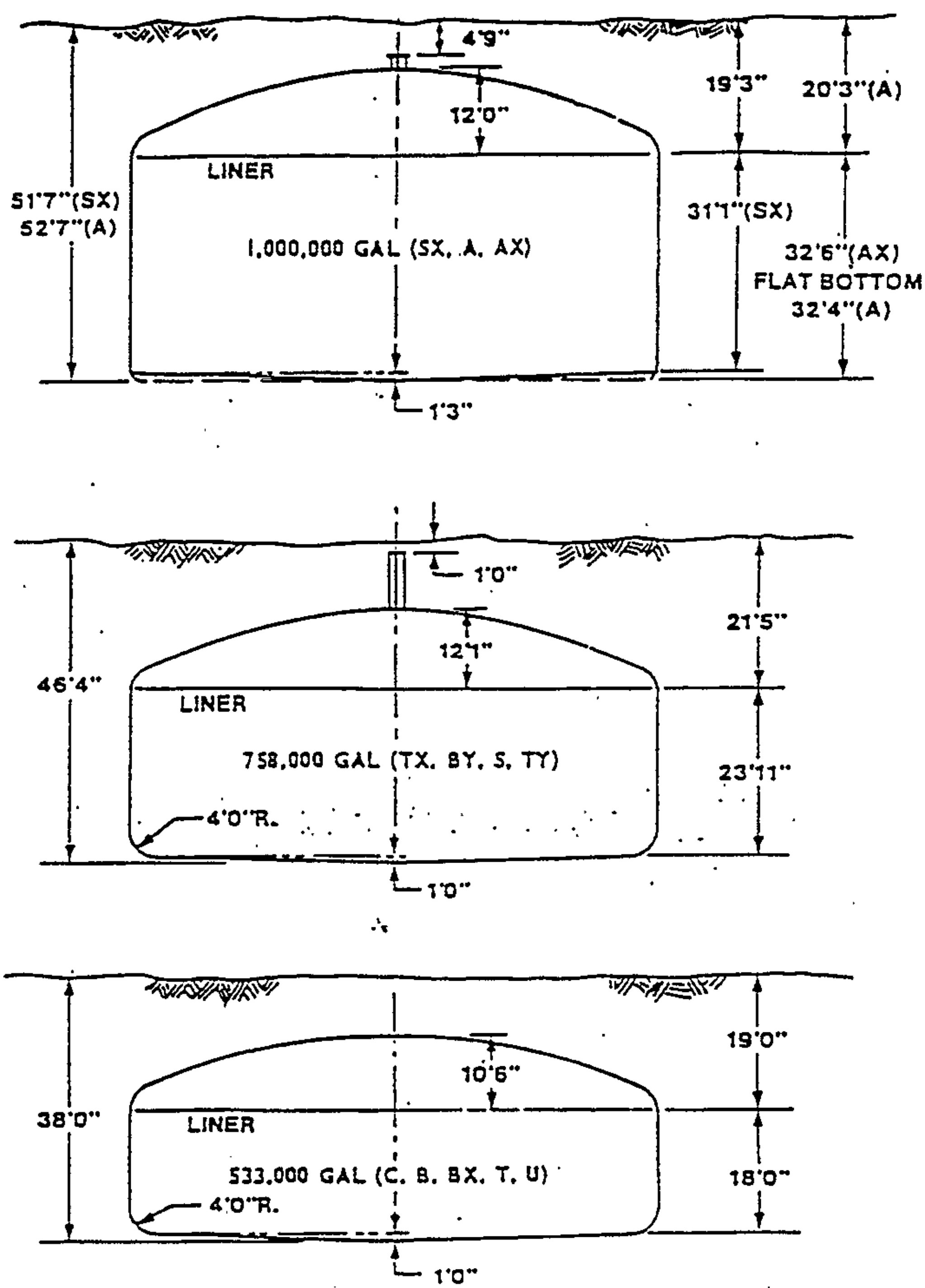
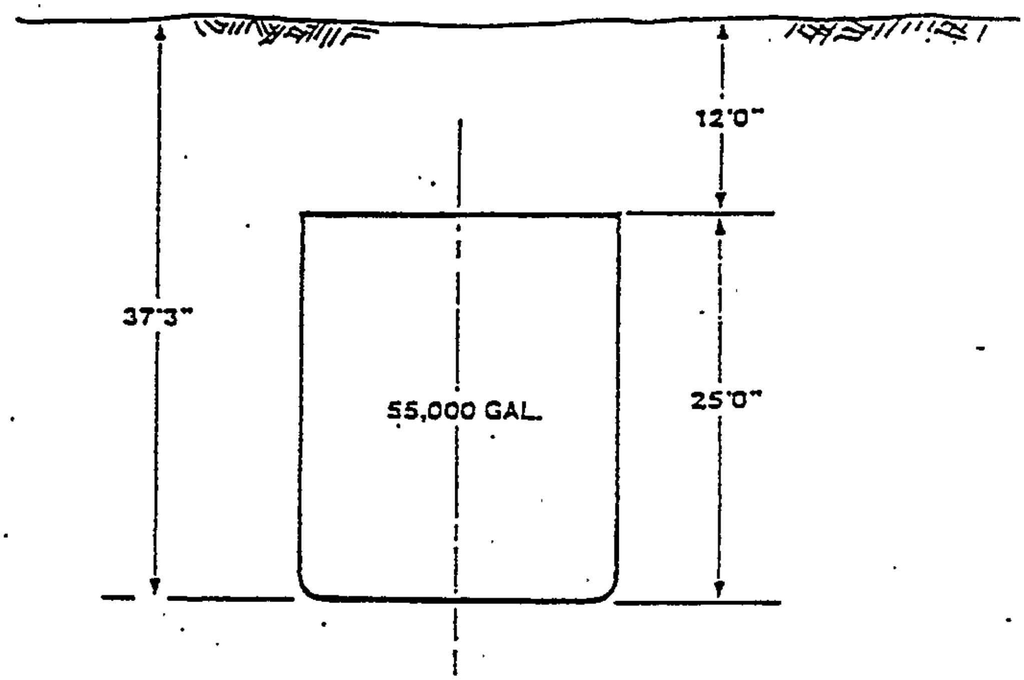


Figure A1. Typical Tank Configuration (3 sheets).
(Backup to Tables 5-2A and 5-2B).



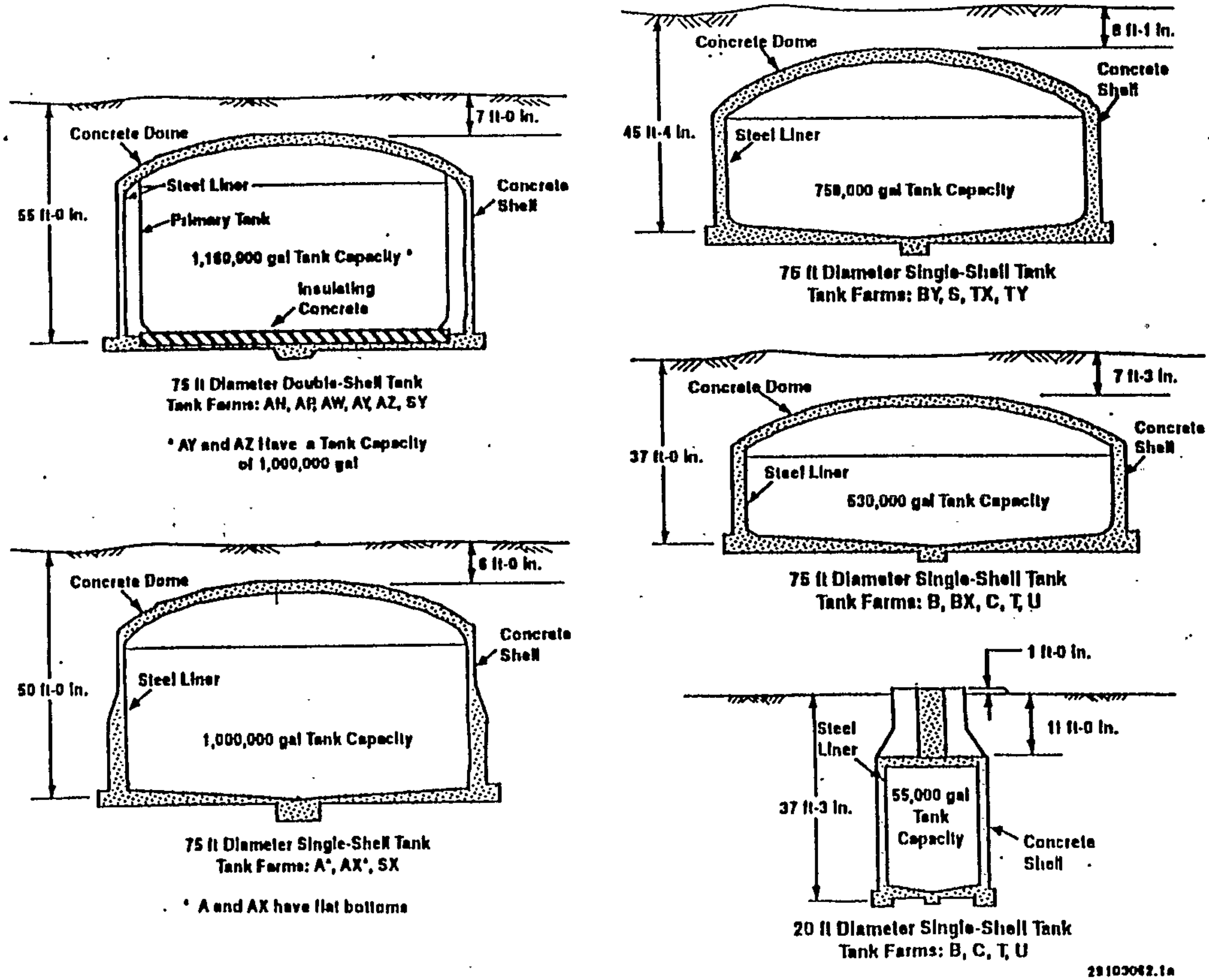


Figure A1. Typical Tank Configuration (3 sheets).
(Backup to Tables 5-2A and 5-2B).

Figure A2. Extensive Separations Pretreatment: Low-Level Waste Grout Vault Configuration (Backup to Tables 5-1, 5-2D, 5-3B and 5-4 through 5-13).

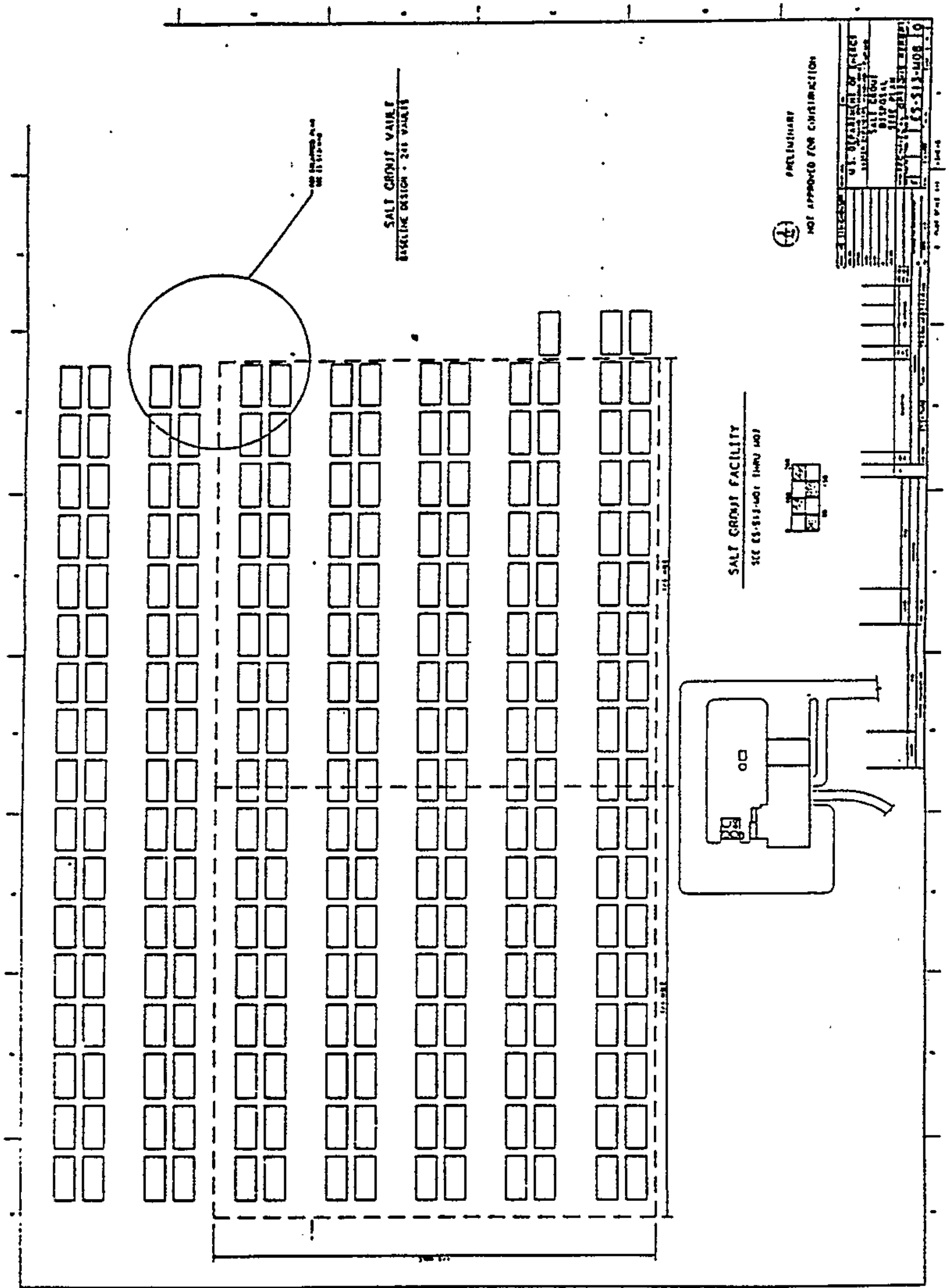
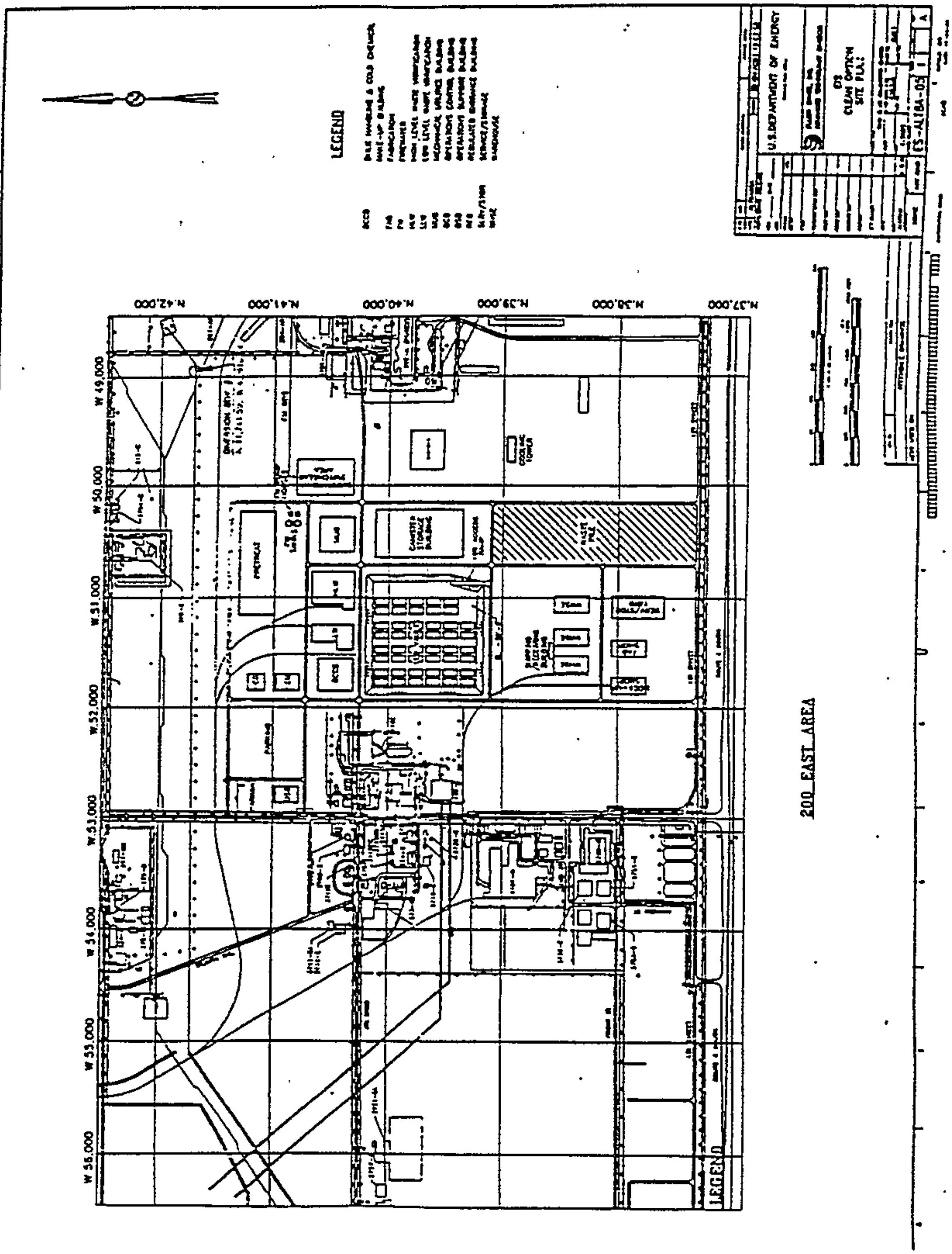


Figure A3. Extensive Separations Pretreatment: Low-Level Waste Glass Vault Configuration (Backup to Table 5-1, 5-2D, 5-3B and 5-4 through 5-13).



This page intentionally left blank.

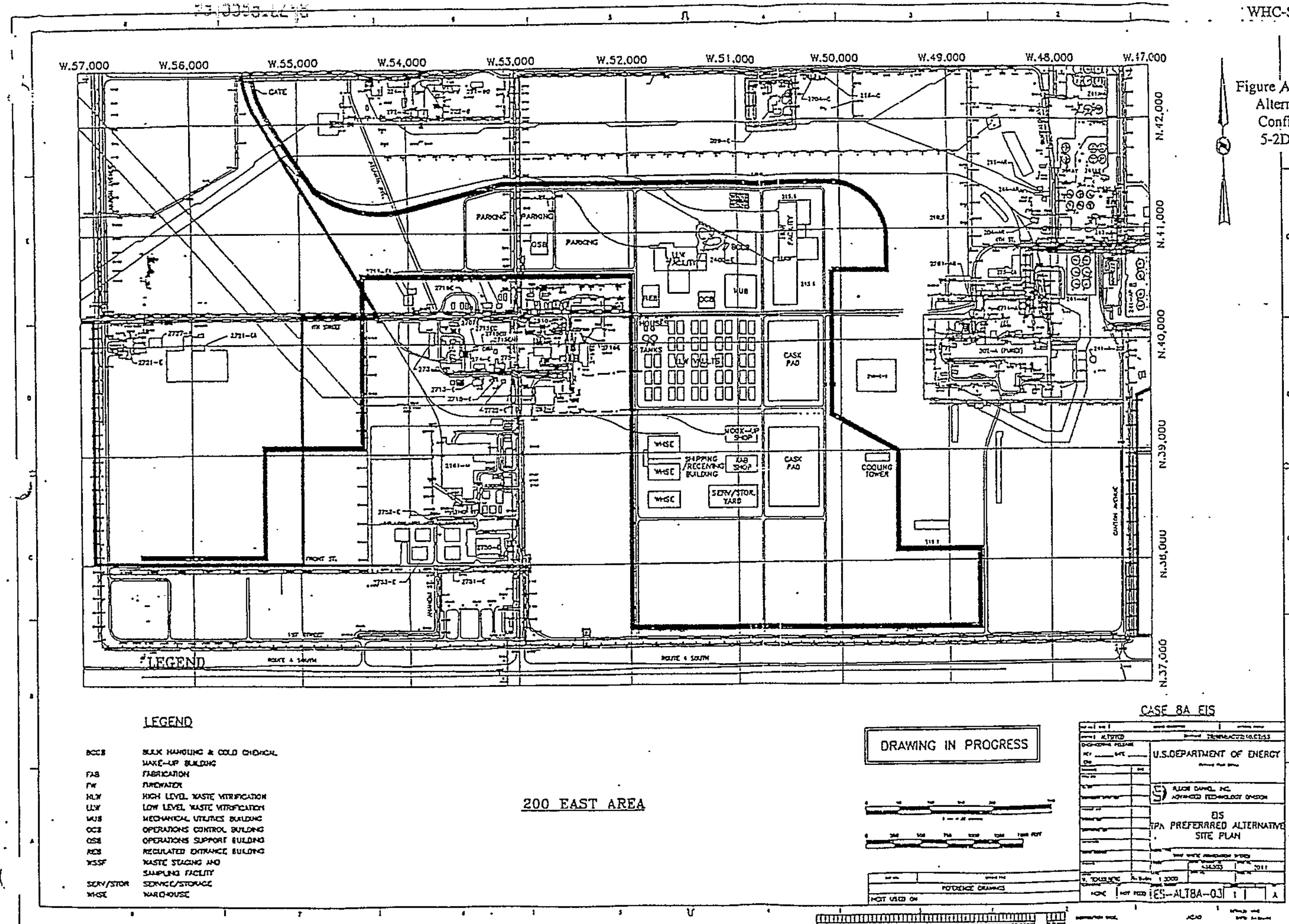


Figure A4. Tri-Party Agreement Preferred Alternative: Low-Level Waste Vault Configuration (Backup to Table 5-1, 5-2D, 5-3B, and 5-4 through 5-13).

Table A1. Tank Volumes (Backup to Tables 5-2A, 5-2B, 5-3A, 5-8, 5-9, 5-11 and 5-12).

TANK FARM	NUMBER TANKS	TANK CAPACITY (gal/tank)	TANK CAPACITY (cu m/tank)	TOT CAP (cu m)	FACTOR	TOTAL VOLUME (gallons)	TOTAL VOLUME (cu m)
A	6	1000000	3780	22680	1.6	9600000	36288
AN*	7	1160000	4384.8	30694	1.6	12992000	49110
AP*	8	1160000	4384.8	35078	1.6	14848000	56125
AW*	6	1160000	4384.8	26309	1.6	11136000	42094
AX	4	1000000	3780	15120	1.6	6400000	24192
AY*	2	1000000	3780	7560	1.6	3200000	12096
AZ*	2	1000000	3780	7560	1.6	3200000	12096
B	12	530000	2003.4	24041	1.6	10176000	38465
B	4	55000	207.9	832	1.6	352000	1331
BX	12	530000	2003.4	24041	1.6	10176000	38465
BY	12	758000	2865.24	34383	1.6	14553600	55013
C	12	530000	2003.4	24041	1.6	10176000	38465
C	4	55000	207.9	832	1.6	352000	1331
S	12	758000	2865.24	34383	1.6	14553600	55013
SX	15	1000000	3780	56700	1.6	24000000	90720
SY*	3	1160000	4384.8	13154	1.6	5568000	21047
T	12	530000	2003.4	24041	1.6	10176000	38465
T	4	55000	207.9	832	1.6	352000	1331
TX	18	758000	2865.24	51574	1.6	21830400	82519
TY	6	758000	2865.24	17191	1.6	7276800	27506
U	12	530000	2003.4	24041	1.6	10176000	38465
U	4	55000	207.9	832	1.6	352000	1331
TOTALS:	177			475917		201446400	761467

NOTES: (1) Asterisks following the Tank Farm letter designators mean that the tank is a DST.

(2) The column "FACTOR" refers to a scaling factor determined by the calculation of the actual volume of Tank C-106, 530,000 gallon tank. It was assumed that all tanks had the same geometry as Tank C-106.

The scaling factor comes from the ratio of the calculated C-106 total tank volume (852,000 gallons) divided by the C-106 tank capacity (530,000 gallons). All tank capacities are from the Updated Monthly Hanford Tank Farm Facilities Report (graphics # 29310073.2C).

(3) The total capacity is the amount of waste that actually is in the 177 waste tanks. 1% of the waste in the SSTs will remain in the tanks after retrieval operations; the DSTs are considered to be "clean-closed". That is, no waste remains in the DSTs after retrieval. Therefore, there is actually 760,000 m^3 of void volume in the tanks to be stabilized [761,467 cu m - (0.01)(135,475 cu m of SST capacity)].

Table A2. Schedules for Tank Stabilization (Backup to Tables 5-2A, 5-2B, 5-2C, 5-3A, 5-11 and 5-12). Tank Stabilization bv Grout

SCHEDULE FOR TANK STABILIZATION BY GROUT

TANK FARM	NUMBER TANKS	TANK CAPACITY (gal/tank)	HEIGHT (ft)	HEIGHT (m)	LIFTS/ TANK	TOTAL LIFTS PER TANK FARM	SCHEDULE (days)	SCHEDULE (years)
A	6	1000000	43	13	15	90	630	2.5
AN*	7	1160000	48	15	16	112	784	3.1
AP*	8	1160000	48	15	16	128	896	3.6
AW*	6	1160000	48	15	16	96	672	2.7
AX	4	1000000	43	13	15	60	420	1.7
AY*	2	1000000	43	13	15	30	210	0.8
AZ*	2	1000000	43	13	15	30	210	0.8
B	12	530000	28.5	9	10	120	840	3.4
B	4	55000	25	8	9	36	252	1.0
BX	12	530000	28.5	9	10	120	840	3.4
BY	12	758000	36	11	12	144	1008	4.0
C	12	530000	28.5	9	10	120	840	3.4
C	4	55000	25	8	9	36	252	1.0
S	12	758000	36	11	12	144	1008	4.0
SX	15	1000000	43	13	15	225	1575	6.3
SY*	3	1160000	48	15	16	48	336	1.3
T	12	530000	28.5	9	10	120	840	3.4
T	4	55000	25	8	9	36	252	1.0
TX	18	758000	36	11	12	216	1512	6.0
TY	6	758000	36	11	12	72	504	2.0
U	12	530000	28.5	9	10	120	840	3.4
U	4	55000	25	8	9	36	252	1.0
TOTALS:	177			242		2139	14973	59.9

NOTE: (1) Double-shelled tanks are designated by an asterisk after the tank farm letter.

(2) The schedule is based upon a maximum depth of 0.91 m (3 ft) per lift of grout, with a curing time of 7 days between lifts. The 55,000 gallon tanks are 25 ft tall and would need 9 lifts, the 530,000 gallon tanks are 28.5 ft tall and would need 10 lifts, the 758,000 gallon tanks are 36 ft tall and would need 12 lifts, the 1,000,000 gallon tanks are 43 ft tall and would need 15 lifts, and the 1,160,000 gallon tanks are 48 ft tall and would need 15 lifts.

(3) The schedule assumes 40 hour workweeks and 250 days per working year.

SCHEDULE FOR TANK STABILIZATION BY GRAVEL

TANK FARM	NUMBER TANKS	TANK CAPACITY (gal/tank)	TANK CAPACITY (cu m/tank)	TOT CAP (cu m)	FACTOR	TOTAL VOLUME (gallons)	TOTAL VOLUME (cu m)	SCHEDULE (days)
A	6	1000000	3780	22680	1.6	9600000	36288	30
AN*	7	1160000	4384.8	30694	1.6	12992000	49110	40.6
AP*	8	1160000	4384.8	35078	1.6	14848000	56125	46.4
AW*	6	1160000	4384.8	26309	1.6	11136000	42094	34.8
AX	4	1000000	3780	15120	1.6	6400000	24192	40
AY*	2	1000000	3780	7560	1.6	3200000	12096	10
AZ*	2	1000000	3780	7560	1.6	3200000	12096	10
B	12	530000	2003.4	24041	1.6	10176000	38465	31.8
B	4	55000	207.9	832	1.6	352000	1331	2.2
BX	12	530000	2003.4	24041	1.6	10176000	38465	31.8
BY	12	758000	2865.24	34383	1.6	14553600	55013	45.48
C	12	530000	2003.4	24041	1.6	10176000	38465	31.8
C	4	55000	207.9	832	1.6	352000	1331	2.2
S	12	758000	2865.24	34383	1.6	14553600	55013	45.48
SX	15	1000000	3780	56700	1.6	24000000	90720	75
SY*	3	1160000	4384.8	13154	1.6	5568000	21047	17.4
T	12	530000	2003.4	24041	1.6	10176000	38465	31.8
T	4	55000	207.9	832	1.6	352000	1331	2.2
TX	18	758000	2865.24	51574	1.6	21830400	82519	68.22
TY	6	758000	2865.24	17191	1.6	7276800	27506	22.74
U	12	530000	2003.4	24041	1.6	10176000	38465	31.8
U	4	55000	207.9	832	1.6	352000	1331	2.2
TOTALS:	177			475917		201446400	761467	653.92

NOTE: (1) All 55,000 gallon tanks will be grout-filled rather than stabilized with gravel.

(2) Schedule assumes that it takes 5 days (8-hour days) to fill one 1,000,000 tank with gravel. All other schedules (with the exception of the 55,000 gallon tanks) are based on this ratio of time/tank size.

Table A3. Ancillary Equipment Associated with Single-Shell Tanks (Backup to Tables 5-2C, 5-3A, 5-8, 5-9, 5-11, and 5-12).

TANK FARM	DESIGNATION	EQUIPMENT TYPE
241-A	241-A-152	Diversion Box
	241-A-153	Diversion Box
	241-A-350	Catch Tank
	241-A-417	Condensate Tank
	241-A-A	Diversion Box
	241-A-B	Diversion Box
241-AX	241-AX-151	Diversion Box
	241-AX-152-CT	Catch Tank
	241-AX-152-DS	Diverter Station
	241-AX-155	Diversion Box
	241-AX-501	Valve Pit
	241-AX-A	Diversion Box
	241-A-B	Diversion Box
241-B	241-B-151	Diversion Box
	241-B-152	Diversion Box
	241-B-153	Diversion Box
	241-B-252	Diversion Box
	241-B-301B	Catch Tank
	241-BR-152	Diversion Box
241-BY	241-BYR-152	Diversion Box
	241-BYR-153	Diversion Box
	241-BYR-154	Diversion Box
	242-B-151	Diversion Box
	244-BXR	Receiving Vault
	2607-EB	Septic Tank
241-BX	241-BX-153	Diversion Box
	241-BX-302A	Catch Tank
	241-BXR-151	Diversion Box
	241-BXR-152	Diversion Box
	241-BXR-143	Diversion Box
241-C	241-C-151	Diversion Box
	241-C-152	Diversion Box
	241-C-153	Diversion Box
	241-C-252	Catch Tank
	241-C-301C	Diversion Box
	241-CR-151	Diversion Box
	241-CR-152	Diversion Box
	241-CR-153	Diversion Box
	241-ER-153	Diversion Box
	2607-ED	Septic Tank
	2607-EG	Septic Tank
	2607-EJ	Septic Tank

TANK FARM	DESIGNATION	EQUIPMENT TYPE
241-S	241-S-151	Diversion Box
	241-S-152	Diversion Box
	241-S-302B	Catch Tank
	241-S-A	Valve Pit
	241-S-B	Valve Pit
	241-S-C	Valve Pit
	241-S-D	Valve Pit
241-SX	241-SX-151	Diversion Box
	241-SX-152	Diversion Box
241-T	241-T-151	Diversion Box
	241-T-152	Diversion Box
	241-T-153	Diversion Box
	241-T-252	Diversion Box
	241-T-301	Catch Tank
	241-T-302	Catch Tank
	241-TR-152	Diversion Box
	241-TR-153	Diversion Box
241-TY	241-TY-153	Diversion Box
	241-TY-302A	Catch Tank
	241-TY-302B	Catch Tank
	241-T-151	Diversion Box
	2607-WTX	Septic Tank
241-TX	241-TX-153	Diversion Box
	241-TX-302A	Catch Tank
	241-TXR-152	Diversion Box
	241-TXR-153	Diversion Box
241-U	241-U-153	Diversion Box
	241-U-252	Diversion Box
	241-U-301	Catch Tank
	241-U-A	Diversion Box
	241-U-B	Diversion Box
	241-U-C	Diversion Box
	241-U-D	Diversion Box
	241-UR-151	Diversion Box
	241-UR-152	Diversion Box
	241-UR-153	Diversion Box
	241-UR-154	Diversion Box
	244-UR	Receiving Vault
	2607-WUT	Septic Tank

Table A4. 241-A Tank Farm Estimated Piping/Structure Voids (Backup to Tables 5-2C, 5-3A, 5-8, 5-9, 5-11, and 5-12).

EQUIPMENT	DESCRIPTION (inch diam)	VOID VOLUME (cu m)	SURFACE AREA OF VOID SPACE IN STRUCTURE (sq m)
Piping	1.5	0.64	62.60
	2	2.93	222.77
	3	13.85	709.01
	4	22.68	885.62
	6	48.91	1342.41
	10	12.46	193.32
	12	16.91	23.52
Risers	4	1.83	71.16
	8	2.50	51.10
	12	5.32	69.68
	20	4.16	33.44
	42	19.03	882.92
Test Wells	8	40.89	603.85
Vapor Header	20	12.13	97.55
	24	35.57	247.95
SUBTOTAL:		239.81	5496.90
Diversion Box	241-A-152	290.56	446.48
Valve Pit	241-A-A & 241-A-B	26.90	72.46
Transfer Box	241-A-153	12.91	37.16
Header Support	Beams/Pilasters		
Encasement		8.55	19.69
Encasement	241-a	57.69	413.68
Encasement	Between Tanks	111.81	210.70
Encasement		5.30	61.96
Encasement		8.10	113.06
Encasement		10.37	127.64
Encasement		25.32	194.72
Encasement Support	Footings/Pilasters/Bolsters		
Sluice/Distributor Pits		89.63	299.60
Pump Pits		139.56	348.56
Leak Detection Casing		441.96	483.27
Thermal Probe Casing		221.77	223.89
SUBTOTAL:		1450.43	3052.87
TOTAL:		1690.24	8549.77

NOTE: (1) Piping includes both encased pipe and direct buried pipe.

Table A5. 241-T Tank Farm Estimated Piping/Structure Voids (Backup to Tables 5-2C, 5-3A, 5-8, 5-9, 5-11 and 5-12).

EQUIPMENT	DESCRIPTION (inch diam)	VOID VOLUME (cu m)	SURFACE AREA OF VOID SPACE IN STRUCTURE (sq m)
Piping	6	27.64	709.20
	3	16.28	821.70
	2	3.31	243.21
Test Well	6	23.79	611.28
Salt Well/Caisson	60	33.42	87.51
Riser	4	1.93	74.69
	12	21.47	271.83
	42	9.52	441.46
SUBTOTAL:		137.36	3260.88
Pits	(9)	163.89	382.93
Diversion/Pump Pit	(5)	244.97	445.92
Diversion Box	241-TR-152	210.70	324.22
Salt Well Pad			18.58
Encasement	241-T-151 & 241-T-152	12.89	118.45
Encasement	Cascade	50.98	401.33
SUBTOTAL:		683.43	1691.43
TOTAL:		820.79	4952.31

NOTE: (1) Piping includes both encased and direct buried pipe.

Table A6. 241-TY Tank Farm Estimated Piping/Structure Voids
(Backup to Tables 5-2C, 5-3A, 5-8, 5-9, 5-11 and 5-12).

EQUIPMENT	DESCRIPTION (inch diam)	VOID VOLUME (cu m)	SURFACE AREA OF VOID SPACE IN STRUCTURE (sq m)
Piping	1.5	0.71	63.82
	2	0.42	33.17
	3	7.73	397.70
	4	0.59	23.41
	6	2.44	63.26
	8	0.79	15.70
Test Well	6	8.16	209.58
Salt Well/Caisson	60	3.34	8.73
Riser	4	1.05	40.88
	12	10.59	134.15
	42	12.69	588.61
SUBTOTAL:		**48.51**	**1579.01**
Pits	(6)	112.15	274.24
Pump Pits	(2)	22.80	60.76
Diversion Box	241-TY-153	210.70	324.22
Encasement		44.75	366.96
Encasement		6.80	59.46
Pipe Support	Beams/Footings/Pilasters		
Salt Well Pad			1.86
SUBTOTAL:		**397.20**	**1087.50**
TOTAL:		**445.71**	**2666.51**

NOTE: (1) Piping includes both encased pipe and direct buried pipe.

Table A7. Summary of Estimated Single-Shell Tank RCRA PPU Void Volumes (Backup to Tables 5-2C, 5-8, 5-9, 5-11 and 5-12).

TANK FARM	PIPING/RISER VOID VOLUME (cu m)	PITS, BOXES, ETC VOID VOLUMES (cu m)	TOTAL VOID VOLUME (cu m)	SCHEDULE (days)
241-A*	239.9	1450.4	1690.3	2.79
241-AX	158.3	957.3	1115.6	1.84
241-B	137.4	683.4	820.8	1.36
241-BX	109.9	546.7	656.6	1.09
241-BY	109.9	546.7	656.6	1.09
241-C	137.4	683.4	820.8	1.36
241-S	109.9	546.7	656.6	1.09
241-SX	137.4	683.4	820.8	1.36
241-T*	137.4	683.4	820.8	1.36
241-TX	192.3	956.8	1149.1	1.90
241-TY*	48.5	397.2	445.7	0.74
241-U	137.4	683.4	820.8	1.36
TOTAL:	1655.5	8819.1	10474.6	17.31

NOTE:

(1) Tank farms which are followed by an asterisk indicate that these void volumes were directly calculated from the preceding tables. All other void volumes were obtained from a scaling factor based on the other tanks' similarities to tanks A and T.

(2) The schedule is derived from the schedule for stabilizing the tanks with grout: the total m^3 of grout volume was divided by the total time for grouting to find a scaling factor. This scaling factor is (761,467 cu m)/(1259.04 days) = 605 cu m/day. All PPU void volumes were divided by this scaling factor to arrive at a preliminary schedule. 10% was added as a contingency factor to the DSTs, in order to compensate for differences in ancillary equipment that may be present.

(3) This schedule assumes 5-day workweeks of 8-hour days.

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

SST 241-A

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	7500	893	128	765	305	207	1.45	7.97	115.03
base course 02	1600	38	5	32			1.45	0.34	3.84
asphalt 03	2500	70	14	56			1.45	1.45	10.36
top coating		232	58	174			1.45	7.2	22.03
drainage layer 04	5400	113	16	97			1.45	1.01	13.38
basalt 05	34300	11079	1584	9495			1.45	98.92	1142.51
filter layers 06	4400	273	39	234			1.45	2.44	32.19
lower silt 07	8000	2208	316	1892			1.45	19.71	185.71
upper silt 08	8900	2305	330	1975			1.45	20.58	193.88
road base 09	300	7	1	6			1.45	0.06	0.38
TOTAL		17217	2491	14726				159.6827	1719.31

SST 241-AX

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	5200	619	88	530	209	207	0.99	5.53	79.75
base course 02	1300	31	4	26			0.99	0.27	3.12
asphalt 03	1900	48	10	38			0.99	0.99	7.07
top coating		158	40	119			0.99	5.0	15.05
drainage layer 04	4200	88	13	76			0.99	0.79	10.41
basalt 05	27000	8721	1247	7474			0.99	77.87	899.35
filter layers 06	3100	192	27	165			0.99	1.72	22.68
lower silt 07	5500	1518	217	1301			0.99	13.55	127.67
upper silt 08	6200	1606	230	1376			0.99	14.34	135.06
road base 09	300	7	1	6			0.99	0.06	0.38
TOTAL		12988	1877	11111				120.0639	1300.55

SST 241-B

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	19800	2356	337	2019	405	378	3.51	21.04	303.68
base course 02	3100	73	10	63			3.51	0.65	7.44
asphalt 03	4700	168	34	135			3.51	3.51	25.08
top coating		562	140	421			3.51	17.6	53.35
drainage layer 04	10000	210	30	180			3.51	1.88	24.78
basalt 05	61200	19768	2827	16941			3.51	176.50	2038.53
filter layers 06	9800	608	87	521			3.51	5.43	71.69
lower silt 07	19300	5327	762	4565			3.51	47.56	448.02
upper silt 08	20600	5335	763	4572			3.51	47.64	448.75
road base 09	500	12	2	10			3.51	0.11	0.63
TOTAL		34419	4992	29427				321.8525	3421.96

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

SST 241 BY

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	15600	1856	265	1591	411	305	2.88	16.58	239.26
base course 02	2700	64	9	55			2.88	0.57	6.48
asphalt 03	4000	138	28	111			2.88	2.88	20.58
top coating		461	115	346			2.80	14.4	43.78
drainage layer 04	8600	181	26	155			2.88	1.61	21.31
basalt 05	53600	17313	2476	14837			2.88	154.58	1785.38
filter layers 06	8200	508	73	436			2.88	4.54	59.99
lower silt 07	15800	4361	624	3737			2.88	38.94	366.77
upper silt 08	17000	4403	630	3773			2.88	39.31	370.32
road base 09	400	10	1	8			2.88	0.09	0.51
TOTAL		29294	4246	25048				273.4882	2914.38

SST 241-BX

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	15400	1833	262	1571	405	305	2.84	16.36	236.19
base course 02	2700	64	9	55			2.84	0.57	6.48
asphalt 03	4000	136	27	109			2.84	2.84	20.29
top coating		454	114	341			2.84	14.2	43.17
drainage layer 04	8500	179	26	153			2.84	1.59	21.06
basalt 05	53000	17119	2448	14671			2.84	152.85	1765.40
filter layers 06	8000	496	71	425			2.84	4.43	58.52
lower silt 07	15600	4306	616	3690			2.84	38.44	362.13
upper silt 08	16800	4351	622	3729			2.84	38.85	365.97
road base 09	400	10	1	8			2.84	0.09	0.51
TOTAL		28947	4196	24751				270.2205	2879.72

SST 241-C

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	20400	2428	347	2080	411	382	3.60	21.68	312.88
base course 02	3200	76	11	65			3.60	0.67	7.68
asphalt 03	4800	173	35	138			3.60	3.60	25.72
top coating		576	144	432			3.60	18.0	54.72
drainage layer 04	10200	214	31	184			3.60	1.91	25.27
basalt 05	62300	20123	2878	17245			3.60	179.67	2075.17
filter layers 06	10000	620	89	531			3.60	5.54	73.15
lower silt 07	19800	5465	781	4683			3.60	48.79	459.63
upper silt 08	21100	5465	781	4683			3.60	48.79	459.64
road base 09	500	12	2	10			3.60	0.11	0.63
TOTAL		35151	5098	30053				328.76	3494.51

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

SST 241-S

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	15900	1892	271	1622	411	309	2.92	16.89	243.86
base course 02	2700	64	9	55			2.92	0.57	6.48
asphalt 03	4100	140	28	112			2.92	2.92	20.86
top coating		467	117	350			2.92	14.6	44.38
drainage layer 04	8700	183	26	157			2.92	1.63	21.56
basalt 05	54000	17442	2494	14948			2.92	155.73	1798.71
filter layers 06	8200	508	73	436			2.92	4.54	59.99
lower silt 07	16000	4416	631	3785			2.92	39.43	371.42
upper silt 08	17200	4455	637	3818			2.92	39.78	374.68
road base 09	500	12	2	10			2.92	0.11	0.63
TOTAL		29579.1	4288	25291				276.1961	2942.57

SST 241-T

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	19800	2356	337	2019	405	378	3.51	21.04	303.68
base course 02	3100	73	10	63			3.51	0.65	7.44
asphalt 03	4700	168	34	135			3.51	3.51	25.08
top coating		562	140	421			3.51	17.6	53.35
drainage layer 04	10000	210	30	180			3.51	1.88	24.78
basalt 05	61200	19768	2827	16941			3.51	176.50	2038.53
filter layers 06	9800	608	87	521			3.51	5.43	71.69
lower silt 07	19300	5327	762	4565			3.51	47.56	448.02
upper silt 08	20600	5335	763	4572			3.51	47.64	448.75
road base 09	500	12	2	10			3.51	0.11	0.63
TOTAL		34418.8	4992	29427				321.8525	3421.96

SST 241-SX

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	20000	2380	340	2040	513	309	3.64	21.25	306.74
base course 02	3200	76	11	65			3.64	0.67	7.68
asphalt 03	4900	175	35	140			3.64	3.64	26.01
top coating		582	146	437			3.64	18.2	55.33
drainage layer 04	10400	218	31	187			3.64	1.95	25.77
basalt 05	63700	20575	2942	17633			3.64	183.71	2121.81
filter layers 06	10200	632	90	542			3.64	5.65	74.62
lower silt 07	20000	5520	789	4731			3.64	49.29	464.27
upper silt 08	21300	5517	789	4728			3.64	49.26	463.99
road base 09	500	12	2	10			3.64	0.11	0.63
TOTAL		35687.2	5176	30512				333.7161	3546.86

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

SST 241-TY

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	7600	904	129	775	309	207	1.47	8.08	116.56
base course 02	1700	40	6	34			1.47	0.36	4.08
asphalt 03	2500	71	14	56			1.47	1.47	10.50
top coating		235	59	176			1.47	7.4	22.34
drainage layer 04	5400	113	16	97			1.47	1.01	13.38
basalt 05	34600	11176	1598	9578			1.47	99.78	1152.50
filter layers 06	4400	273	39	234			1.47	2.44	32.19
lower silt 07	8200	2263	324	1940			1.47	20.21	190.35
upper silt 08	9000	2331	333	1998			1.47	20.81	196.05
road base 09	300	7	1	6			1.47	0.06	0.38
TOTAL		17413.7	2519	14894				161.5693	1738.35

SST 241-TX

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	28600	3403	487	2917	513	411	4.84	30.39	438.64
base course 02	4000	94	13	81			4.84	0.84	9.60
asphalt 03	6100	232	46	186			4.84	4.84	34.58
top coating		774	194	581			4.84	24.2	73.57
drainage layer 04	12800	269	38	230			4.84	2.40	31.72
basalt 05	77300	24968	3570	21397			4.84	222.93	2574.81
filter layers 06	13200	818	117	701			4.84	7.31	96.56
lower silt 07	26500	7314	1046	6268			4.84	65.30	615.16
upper silt 08	28000	7252	1037	6215			4.84	64.75	609.95
road base 09	600	14	2	12			4.84	0.13	0.76
TOTAL		45140	6551	38589				423.0873	4485.36

SST 241-U

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	19200	2285	327	1958	405	368	3.42	20.40	294.47
base course 02	3100	73	10	63			3.42	0.65	7.44
asphalt 03	4600	164	33	131			3.42	3.42	24.44
top coating		547	137	410			3.42	17.1	51.98
drainage layer 04	9800	206	29	176			3.42	1.84	24.28
basalt 05	60113	19416	2777	16640			3.42	173.36	2002.33
filter layers 06	9600	595	85	510			3.42	5.31	70.23
lower silt 07	18800	5189	742	4447			3.42	46.33	436.42
upper silt 08	20100	5206	744	4461			3.42	46.48	437.85
road base 09	500	12	2	10			3.42	0.11	0.63
TOTAL		33694	4886	28807				315.0036	3350.08

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

DST AN

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	12500	1488	213	1275	319	319	2.34	13.28	191.71
base course 02	2300	54	8	47			2.34	0.48	5.52
asphalt 03	3400	112	22	90			2.34	2.34	16.72
top coating		374	94	281			2.34	11.7	35.57
drainage layer 04	7400	155	22	133			2.34	1.39	18.34
basalt 05	46200	14923	2134	12789			2.34	133.24	1538.89
filter layers 06	6700	415	59	356			2.34	3.71	49.01
lower silt 07	12900	3560	509	3051			2.34	31.79	299.46
upper silt 08	13900	3600	515	3085			2.34	32.14	302.79
road base 09	400	10	1	8			2.34	0.09	0.51
TOTAL		24692	3577	21115				230.1586	2458.52

DST AP

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	10700	1273	182	1091	426	212	2.07	11.37	164.11
base course 02	2200	52	7	44			2.07	0.46	5.28
asphalt 03	3200	99	20	79			2.07	2.07	14.79
top coating		331	83	248			2.07	10.4	31.46
drainage layer 04	7000	147	21	126			2.07	1.31	17.34
basalt 05	44100	14244	2037	12207			2.07	127.18	1468.94
filter layers 06	6100	378	54	324			2.07	3.38	44.62
lower silt 07	11500	3174	454	2720			2.07	28.34	266.96
upper silt 08	12500	3238	463	2775			2.07	28.91	272.30
road base 09	400	10	1	8			2.07	0.09	0.51
TOTAL		22946	3322	19624				213.4541	2286.32

DST AW

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	8000	952	136	816	319	212	1.55	8.50	122.70
base course 02	1700	40	6	34			1.55	0.36	4.08
asphalt 03	2600	74	15	60			1.55	1.55	11.07
top coating		248	62	186			1.55	7.8	23.56
drainage layer 04	5600	118	17	101			1.55	1.05	13.88
basalt 05	35800	11563	1654	9910			1.55	103.24	1192.48
filter layers 06	4600	285	41	244			1.55	2.55	33.65
lower silt 07	8600	2374	339	2034			1.55	21.19	199.64
upper silt 08	9500	2461	352	2109			1.55	21.97	206.95
road base 09	300	7	1	6			1.55	0.06	0.38
TOTAL		18122	2622	15500				168.2252	1808.38

Table A8. Comparison of Alternatives by Unit Process:
Barrier Construction Personnel Requirements (7 sheets).
(Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

DST AY

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	2900	345	49	296	212	105	0.51	3.08	44.48
base course 02	900	21	3	18			0.51	0.19	2.16
asphalt 03	1300	24	5	20			0.51	0.51	3.64
top coating		82	20	61			0.51	2.6	7.75
drainage layer 04	2900	61	9	52			0.51	0.54	7.19
basalt 05	19300	6234	891	5342			0.51	55.66	642.87
filter layers 06	1800	112	16	96			0.51	1.00	13.17
lower silt 07	2900	800	114	686			0.51	7.15	67.32
upper silt 08	3400	881	126	755			0.51	7.86	74.06
road base 09	200	5	1	4			0.51	0.04	0.25
TOTAL		8565	1235	7330				78.58268	862.90

DST AZ

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	2900	345	49	296	212	105	0.51	3.08	44.48
base course 02	900	21	3	18			0.51	0.19	2.16
asphalt 03	1300	24	5	20			0.51	0.51	3.64
top coating		82	20	61			0.51	2.6	7.75
drainage layer 04	2900	61	9	52			0.51	0.54	7.19
basalt 05	19300	6234	891	5342			0.51	55.66	642.87
filter layers 06	1800	112	16	96			0.51	1.00	13.17
lower silt 07	2900	800	114	686			0.51	7.15	67.32
upper silt 08	3400	881	126	755			0.51	7.86	74.06
road base 09	200	5	1	4			0.51	0.04	0.25
TOTAL		8565	1235	7330				78.58268	862.90

DST SY

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	5400	643	92	551	212	212	1.03	5.74	82.82
base course 02	1300	31	4	26			1.03	0.27	3.12
asphalt 03	1900	49	10	40			1.03	1.03	7.36
top coating		165	41	124			1.03	5.2	15.66
drainage layer 04	4300	90	13	77			1.03	0.81	10.65
basalt 05	27600	8915	1275	7640			1.03	79.60	919.34
filter layers 06	3200	198	28	170			1.03	1.77	23.41
lower silt 07	5800	1601	229	1372			1.03	14.29	134.64
upper silt 08	6500	1684	241	1443			1.03	15.03	141.59
road base 09	300	7	1	6			1.03	0.06	0.38
TOTAL		13383	1934	11448				123.7539	1338.97

Table A8. Comparison of Alternatives by Unit Process: Barrier Construction Personnel Requirements (7 sheets). (Backup to Tables 5-1, 5-2D, 5-3A and B, and 5-4 through 5-13).

EPT OPTION B

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	1835800	218460	31240	187220	2761	1800	114.09	1950.54	28156.01
base course 02	67800	1600	229	1371			114.09	14.29	162.79
asphalt 03	101700	5476	1095	4381			114.09	114.09	815.17
top coating		18254	4564	13691			114.09	570.5	1734.17
drainage layer 04	206300	4332	620	3713			114.09	38.68	511.17
basalt 05	1096700	354234	50655	303579			114.09	3162.80	36530.39
filter layers 06	283400	17571	2513	15058			114.09	156.88	2073.20
lower silt 07	615800	169961	24304	145656			114.09	1517.51	14294.92
upper silt 08	623300	161435	23085	138350			114.09	1441.38	13577.81
road base 09	2600	62	9	53			114.09	0.56	3.30
TOTAL		951386	138314	813073				8967.177	97858.94

TPA PREFERRED ALT

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	143800	17112	2447	14665	1030	747	17.66	152.79	2205.49
base course 02	12100	286	41	245			17.66	2.55	29.05
asphalt 03	18200	848	170	678			17.66	17.66	126.18
top coating		2826	706	2119			17.66	88.3	268.43
drainage layer 04	37500	788	113	675			17.66	7.03	92.92
basalt 05	213100	68831	9843	58988			17.66	614.57	7098.23
filter layers 06	45600	2827	404	2423			17.66	25.24	333.58
lower silt 07	95900	26468	3785	22683			17.66	236.33	2226.18
upper silt 08	98800	25589	3659	21930			17.66	228.48	2152.23
road base 09	1000	24	3	21			17.66	0.21	1.27
TOTAL		145599	21171	124427				1373.151	14533.57

EPT OPTION A

BARRIER LAYER	VOLUME (cu yd)	TOTAL STFHR	CONSTR STFHR	SUPVSR STFHR	LENGTH (ft)	WIDTH (ft)	ACRES	DAYS	FUEL (cu m)
site grading 01	159300	18957	2711	16246	930	880	18.79	169.26	2443.21
base course 02	12800	302	43	259			18.79	2.70	30.73
asphalt 03	19100	902	180	722			18.79	18.79	134.25
top coating		3006	752	2255			18.79	94.0	285.61
drainage layer 04	39500	830	119	711			18.79	7.41	97.87
basalt 05	223400	72158	10319	61840			18.79	644.27	7441.31
filter layers 06	48400	3001	429	2572			18.79	26.79	354.07
lower silt 07	101900	28124	4022	24103			18.79	251.11	2365.46
upper silt 08	104900	27169	3885	23284			18.79	242.58	2285.12
road base 09	1100	26	4	23			18.79	0.24	1.40
TOTAL		154476	22463	132012				1457.09	15439.04

NOTE: All barrier length and width measurements include a 9 meter overhang on each side of the tank farm.

STFHR means Staff Hours, and is based on a 5 day workweek, and a 250 day work year.

Table A9. Material Quantities (Backup for Tables 5-1, 5-2D, 5-3B, 5-4 through 5-13).

BACKUP TABLE FOR BARRIER MATERIAL QUANTITIES (IN CU YD)

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U	DST AN	DST AP	DST AW	DST AY	DST AZ	DST SY	EX PRE OPT B	EX PRE OPT A	TPA GLASS
Fill	7,509	5,228	19,785	15,387	15,627	20,366	15,868	20,040	19,785	28,572	7,604	19,175	12,534	10,663	8,042	2,891	2,891	5,421	1,835,827	159,259	143,823
Base Course	1,642	1,264	3,128	2,662	2,692	3,190	2,718	3,248	3,128	4,035	1,658	3,064	2,293	2,152	1,724	868	868	1,296	67,817	12,761	12,111
Asphalt	2,463	1,896	4,691	3,992	4,039	4,784	4,077	4,873	4,691	6,053	2,487	4,596	3,440	3,228	2,586	1,302	1,302	1,944	101,725	19,142	18,166
Drain Gravel	5,369	4,178	9,986	8,545	8,641	10,178	8,721	10,372	9,986	12,794	5,419	9,789	7,397	6,973	5,626	2,930	2,930	4,278	206,301	39,498	37,527
Basalt	34,295	26,970	61,243	52,996	53,563	62,347	54,019	63,728	61,243	77,291	34,601	60,113	46,232	44,112	35,849	19,322	19,322	27,585	1,096,666	223,440	213,115
Gravel Filter	2,941	2,098	6,573	5,397	5,472	6,729	5,537	6,818	6,573	8,869	2,976	6,412	4,511	4,087	3,128	1,210	1,210	2,169	189,168	32,356	30,504
Sand Filter	1,428	1,014	3,225	2,642	2,679	3,302	2,711	3,344	3,225	4,362	1,445	3,145	2,204	1,992	1,521	577	577	1,049	94,242	16,040	15,116
Lower Silt	8,046	5,545	19,285	15,599	15,828	19,773	16,033	19,974	19,285	26,485	8,150	18,780	12,876	11,463	8,610	2,903	2,903	5,756	615,806	101,929	95,665
Upper Silt	8,902	6,243	20,587	16,781	17,020	21,091	17,231	21,340	20,587	28,019	9,012	20,066	13,940	12,526	9,497	3,438	3,438	6,467	623,327	104,922	98,803
Road	334	281	485	444	448	491	450	507	485	563	337	479	404	404	345	226	226	286	2,584	1,056	1,037

BACKUP TABLE FOR BARRIER MATERIAL QUANTITIES (IN CU M)

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U	DST AN	DST AP	DST AW	DST AY	DST AZ	DST SY	EX PRE OPT B	EX PRE OPT A	TPA GLASS
Fill	5,741	3,997	15,127	11,764	11,948	15,571	12,132	15,322	15,127	21,845	5,814	14,660	9,583	8,152	6,149	2,210	2,210	4,145	1,403,582	121,761	109,960
Base Course	1,255	966	2,392	2,035	2,058	2,439	2,078	2,483	2,392	3,085	1,268	2,343	1,753	1,645	1,318	664	664	991	51,849	9,756	9,259
Asphalt	1,883	1,450	3,587	3,052	3,088	3,658	3,117	3,726	3,587	4,628	1,901	3,514	2,630	2,468	1,977	995	995	1,486	77,774	14,635	13,889
Drain Gravel	4,105	3,194	7,635	6,533	6,606	7,782	6,668	7,930	7,635	9,782	4,143	7,484	5,655	5,331	4,301	2,240	2,240	3,271	157,727	30,198	28,691
Basalt	26,220	20,620	46,823	40,518	40,952	47,667	41,300	48,723	46,823	59,093	26,454	45,959	35,347	33,726	27,408	14,773	14,773	21,090	838,456	170,831	162,937
Gravel Filter	2,249	1,604	5,025	4,126	4,184	5,145	4,233	5,213	5,025	6,781	2,275	4,902	3,449	3,125	2,392	925	925	1,658	144,628	24,738	23,322
Sand Filter	1,092	775	2,466	2,020	2,048	2,525	2,073	2,557	2,466	3,335	1,105	2,405	1,685	1,523	1,163	441	441	802	72,053	12,263	11,557
Lower Silt	6,152	4,239	14,744	11,926	12,101	15,117	12,258	15,271	14,744	20,249	6,231	14,358	9,844	8,764	6,583	2,219	2,219	4,401	470,814	77,930	73,294
Upper Silt	6,806	4,773	15,740	12,830	13,013	16,125	13,174	16,315	15,740	21,422	6,890	15,341	10,658	9,577	7,261	2,629	2,629	4,944	476,565	80,218	75,540
Road	255	215	371	339	343	375	344	388	371	430	258	366	309	309	264	173	173	219	1,976	807	793

BACKUP TABLE FOR BARRIER MASS BY LAYER (IN KG)

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U	DST AN	DST AP	DST AW	DST AY	DST AZ	DST SY	EX PRE OPT B	EX PRE OPT A	TPA GLASS
Fill	1.10E+07	7.68E+06	2.91E+07	2.26E+07	2.30E+07	2.99E+07	2.33E+07	2.95E+07	2.91E+07	4.20E+07	1.12E+07	2.82E+07	1.84E+07	1.57E+07	1.18E+07	4.25E+06	4.25E+06	7.97E+06	2.70E+09	2.34E+08	2.11E+08
Base Course	2.41E+06	1.86E+06	4.60E+06	3.91E+06	3.96E+06	4.69E+06	3.99E+06	4.77E+06	4.60E+06	5.93E+06	2.44E+06	4.50E+06	3.37E+06	3.16E+06	2.53E+06	1.28E+06	1.28E+06	1.90E+06	9.97E+07	1.88E+07	1.78E+07
Asphalt																					
Drain Gravel	7.76E+06	6.04E+06	1.44E+07	1.23E+07	1.25E+07	1.47E+07	1.26E+07	1.50E+07	1.44E+07	1.85E+07	7.83E+06	1.41E+07	1.07E+07	1.01E+07	8.13E+06	4.23E+06	4.23E+06	6.18E+06	2.98E+08	5.71E+07	5.42E+07
Basalt	5.29E+07	4.16E+07	9.45E+07	8.18E+07	8.27E+07	9.62E+07	8.34E+07	9.83E+07	9.45E+07	1.19E+08	5.34E+07	9.28E+07	7.13E+07	6.81E+07	5.53E+07	2.98E+07	2.98E+07	4.26E+07	1.69E+09	3.45E+08	3.29E+08
Gravel Filter	4.25E+06	3.03E+06	9.50E+06	7.80E+06	7.91E+06	9.72E+06	8.00E+06	9.85E+06	9.50E+06	1.28E+07	4.30E+06	9.27E+06	6.52E+06	5.91E+06	4.52E+06	1.75E+06	1.75E+06	3.13E+06	2.73E+08	4.68E+07	4.41E+07
Sand Filter	2.06E+06	1.47E+06	4.66E+06	3.82E+06	3.87E+06	4.77E+06	3.92E+06	4.83E+06	4.66E+06	6.30E+06	2.09E+05	4.55E+06	3.19E+06	2.88E+06	2.20E+06	8.34E+05	8.34E+05	1.52E+06	1.36E+08	2.32E+07	2.18E+07
Lower Silt	8.67E+06	5.98E+06	2.08E+07	1.68E+07	1.71E+07	2.13E+07	1.73E+07	2.15E+07	2.08E+07	2.85E+07	8.78E+06	2.02E+07	1.39E+07	1.24E+07	9.28E+06	3.13E+06	3.13E+06	6.20E+06	6.64E+08	1.10E+08	1.03E+08
Upper Silt	9.59E+06	6.73E+06	2.22E+07	1.81E+07	1.83E+07	2.27E+07	1.86E+07	2.30E+07	2.22E+07	3.02E+07	9.71E+06	2.16E+07	1.50E+07	1.35E+07	1.02E+07	3.71E+06	3.71E+06	6.97E+06	6.72E+08	1.13E+08	1.06E+08
Road	5.15E+05	4.34E+05	7.48E+05	6.85E+05	6.91E+05	7.58E+05	6.94E+05	7.82E+05	7.48E+05	8.69E+05	5.20E+05	7.39E+05	6.23E+05	6.23E+05	5.32E+05	3.49E+05	3.49E+05	4.41E+05	3.99E+06	1.63E+06	1.60E+06

SST VOLUMES IN CU YD

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U	TOTALS
Fill	7,509	5,228	19,785	15,387	15,627	20,366	15,868	20,040	19,785	28,572	7,604	19,175	194946
Base Course	1,642	1,264	3,128	2,662	2,692	3,190	2,718	3,248	3,128	4,035	1,658	3,064	32429
Asphalt	2,463	1,896	4,691	3,992	4,039	4,784	4,077	4,873	4,691	6,053	2,487	4,596	48642
Drain Gravel	5,369	4,178	9,986	8,545	8,641	10,178	8,721	10,372	9,986	12,794	5,419	9,789	103978
Basalt	34,295	26,970	61,243	52,996	53,563	62,347	54,019	63,728	61,243	77,291	34,601	60,113	642409
Gravel Filter	2,941	2,098	6,573	5,397	5,472	6,729	5,537	6,818	6,573	8,869	2,976	6,412	66395
Sand Filter	1,428	1,014	3,225	2,642	2,679	3,302	2,711	3,344	3,225	4,362	1,445	3,145	32522
Lower Silt	8,046	5,545	19,285	15,599	15,828	19,773	16,033	19,974	19,285	26,485	8,150	18,780	192783
Upper Silt	8,902	6,243	20,587	16,781	17,020	21,091	17,231	21,340	20,587	28,019	9,012	20,066	206879
Road	334	281	485	444	448	491	450	507	485	563	337	479	5304

SST VOLUMES IN CU M

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U	TOTALS
Fill	5,741	3,997	15,127	11,764	11,948	15,571	12,132	15,322	15,127	21,845	5,814	14,660	149046
Base Course	1,255	966	2,392	2,035	2,058	2,439	2,078	2,483	2,392	3,085	1,268	2,343	24794
Asphalt	1,883	1,450	3,587	3,052	3,088	3,658	3,117	3,726	3,587	4,628	1,901	3,514	37189
Drain Gravel	4,105	3,194	7,635	6,533	6,606	7,782	6,668	7,930	7,635	9,782	4,143	7,484	79496
Basalt	26,220	20,620	46,823	40,518	40,952	47,667	41,300	48,723	46,823	59,093	26,454	45,959	491154
Gravel Filter	2,249	1,604	5,025	4,126	4,184	5,145	4,233	5,213	5,025	6,781	2,275	4,902	50762
Sand Filter	1,092	775	2,466	2,020	2,048	2,525	2,073	2,557	2,466	3,335	1,105	2,405	24865
Lower Silt	6,152	4,239	14,744	11,926	12,101	15,117	12,258	15,271	14,744	20,249	6,231	14,358	147392
Upper Silt	6,806	4,773	15,740	12,830	13,013	16,125	13,174	16,315	15,740	21,422	6,890	15,341	158169
Road	255	215	371	339	343	375	344	388	371	430	258	366	4055

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

BACKUP TABLE FOR BARRIER CONSTRUCTION EMISSIONS (TANK FARMS)

EQUIPMENT DESCRIPTION	POWER (hp)	AP-42 CATEGORY	NUMBER OF UNITS	TOTAL USEAGE (hours)	FUEL USED (cu m/8 hr shift)	PARTICULATES (kg)	CO (kg)	SOx (kg)	HYDROCARBONS (kg)	NOx (kg)	ALDEHYDES (kg)	ORGANIC ACIDS (kg)	THERMAL RELEASES (J)
1/4 TON PICKUP	250	LDG 11	3	37800	0.066	262	10078		806	1209		N/A	8.88E+12
D8 DOZER	335	WHEELED DOZER D	1	21300	3.04	1598	17398	3365	1850	40239	828	N/A	2.30E+14
CAT 966 LOADER	200	WHEELED LOADER D	1	15800	1.82	1231	4101	1304	1788	13559	297	N/A	1.02E+14
10 YD^3 DUMP TRUCK	250	OFF HWY TRUCK D	8	162000	1.52	150336	1058586	266976	112545	2448351	66096	N/A	8.76E+14
CAT 14G MOTOR GRADER	200	MOTOR GRADER D	1	2770	1.82	77	190	108	50	899	15	N/A	1.79E+13
CAT 235 B BACKHOE	215	MISC D	1	5520	1.82	349	1691	357	383	4235	77	N/A	3.57E+13
COMPACTOR		MISC D	1	1570	2.13	99	481	102	109	1205	22	N/A	1.18E+13
5000-GAL WATER TANKER	300	OFF HWY TRUCK D	1	8308	1.52	964	6786	1711	721	15695	424	N/A	4.49E+13
FUEL/LUBE TRUCK	250	OFF HWY TRUCK D	1	8308	1.52	964	6786	1711	721	15695	424	N/A	4.49E+13
TOTAL:						155879	1106097	275635	118973	2541088	67983	N/A	1.37E+15

BACKUP TABLE FOR BARRIER CONSTRUCTION EMISSIONS (EXTENSIVE PRETREATMENT: OPTION B)

EQUIPMENT DESCRIPTION	POWER (hp)	AP-42 CATEGORY	NUMBER OF UNITS	TOTAL USEAGE (hours)	FUEL USED (cu m/8 hr shift)	PARTICULATES (kg)	CO (kg)	SOx (kg)	HYDROCARBONS (kg)	NOx (kg)	ALDEHYDES (kg)	ORGANIC ACIDS (kg)	THERMAL RELEASES (J)
1/4 TON PICKUP	250	LDG 11	3	118000	0.066	822	31558		2528	3792		N/A	2.77E+13
D8 DOZER	335	WHEELED DOZER D	1	62200	3.04	4665	50806	9828	5401	117506	1835	N/A	6.73E+14
CAT 966 LOADER	200	WHEELED LOADER D	1	48900	1.82	3809	12693	4034	5534	41965	919	N/A	3.17E+14
10 YD^3 DUMP TRUCK	250	OFF HWY TRUCK D	8	505000	1.52	468640	3298812	832240	350834	7632208	206040	N/A	2.73E+15
CAT 14G MOTOR GRADER	200	MOTOR GRADER D	1	20000	1.82	554	1368	780	361	6489	111	N/A	1.30E+14
CAT 235 B BACKHOE	215	MISC D	1	19000	1.82	1201	5821	1229	1318	14579	264	N/A	1.23E+14
COMPACTOR		MISC D	1	10700	2.13	678	3278	692	742	8210	149	N/A	8.11E+13
5000-GAL WATER TANKER	300	OFF HWY TRUCK D	1	25900	1.52	3004	21155	5335	2249	48929	1321	N/A	1.40E+14
FUEL/LUBE TRUCK	250	OFF HWY TRUCK D	1	25900	1.52	3004	21155	5335	2249	48929	1321	N/A	1.40E+14
TOTAL:						486376	3447789	859474	371216	7822608	211960	N/A	4.36E+15

BACKUP TABLE FOR BARRIER CONSTRUCTION EMISSIONS (EXTENSIVE PRETREATMENT: OPTION A)

EQUIPMENT DESCRIPTION	POWER (hp)	AP-42 CATEGORY	NUMBER OF UNITS	TOTAL USEAGE (hours)	FUEL USED (cu m/8 hr shift)	PARTICULATES (kg)	CO (kg)	SOx (kg)	HYDROCARBONS (kg)	NOx (kg)	ALDEHYDES (kg)	ORGANIC ACIDS (kg)	THERMAL RELEASES (J)
1/4 TON PICKUP	250	LDG 11	3	50400	0.066	353	13574		1088	1629		N/A	1.16E+13
D8 DOZER	335	WHEELED DOZER D	1	27800	3.04	2085	22707	4392	2414	52519	820	N/A	3.01E+14
CAT 966 LOADER	200	WHEELED LOADER D	1	21100	1.82	1644	5477	1741	2388	18108	397	N/A	1.37E+14
10 YD^3 DUMP TRUCK	250	OFF HWY TRUCK D	8	217000	1.52	201376	1417882	357618	150754	3278582	88538	N/A	1.17E+15
CAT 14G MOTOR GRADER	200	MOTOR GRADER D	1	4400	1.82	122	301	172	80	1427	24	N/A	2.85E+13
CAT 235 B BACKHOE	215	MISC D	1	7800	1.82	483	2390	505	541	5885	108	N/A	5.05E+13
COMPACTOR		MISC D	1	2460	2.13	155	754	158	171	1888	34	N/A	1.88E+13
5000-GAL WATER TANKER	300	OFF HWY TRUCK D	1	11200	1.52	1299	9148	2307	973	21158	571	N/A	6.06E+13
FUEL/LUBE TRUCK	250	OFF HWY TRUCK D	1	11200	1.52	1289	9148	2307	973	21159	571	N/A	6.06E+13
TOTAL:						208826	1481481	369199	159379	3403455	91062	N/A	1.84E+15

BACKUP TABLE FOR BARRIER CONSTRUCTION EMISSIONS (TPA PREFERRED: CLASS)

EQUIPMENT DESCRIPTION	POWER (hp)	AP-42 CATEGORY	NUMBER OF UNITS	TOTAL USEAGE (hours)	FUEL USED (cu m/8 hr shift)	PARTICULATES (kg)	CO (kg)	SOx (kg)	HYDROCARBONS (kg)	NOx (kg)	ALDEHYDES (kg)	ORGANIC ACIDS (kg)	THERMAL RELEASES (J)
1/4 TON PICKUP	250	LDG 11	3	49700	0.066	348	13373		1070	1605		N/A	1.17E+13
D8 DOZER	335	WHEELED DOZER D	1	27400	3.04	2055	22381	4329	2378	51783	808	N/A	2.96E+14
CAT 966 LOADER	200	WHEELED LOADER D	1	20800	1.82	1620	5398	1716	2354	17850	391	N/A	1.35E+14
10 YD^3 DUMP TRUCK	250	OFF HWY TRUCK D	8	214000	1.52	198582	1398378	352672	148870	3234242	87312	N/A	1.16E+15
CAT 14G MOTOR GRADER	200	MOTOR GRADER D	1	4250	1.82	118	281	168	77	1378	24	N/A	2.75E+13
CAT 235 B BACKHOE	215	MISC D	1	7660	1.82	484	2347	486	531	5878	106	N/A	4.86E+13
COMPACTOR		MISC D	1	2380	2.13	150	729	154	165	1826	33	N/A	1.80E+13
5000-GAL WATER TANKER	300	OFF HWY TRUCK D	1	11000	1.52	1276	8985	2266	955	20781	561	N/A	5.95E+13
FUEL/LUBE TRUCK	250	OFF HWY TRUCK D	1	11000	1.52	1276	8985	2266	955	20781	561	N/A	5.95E+13
TOTAL:						205920	1460888	364065	157157	3358104	88796	N/A	1.81E+15

NOTES:

(1) AP-42 Categories: LDG = light-duty gasoline engine, D = diesel engine

(2) There are assumed to be three pickup trucks which run 80 miles/day; therefore, 3 hours/day/truck was assumed for the total usage

(3) The SOx emissions are estimated using a fuel-specific emission factor of 3.23 g SOx per gallon of diesel fuel (0.00712 lbs of SOx/gallon diesel) burned. This factor is based upon the Clean Air Act maximum permissible diesel fuel sulfur content of 0.05% by weight.

(4) Quantities for particulates, carbon monoxide, sulfur oxides, hydrocarbons, nitrogen oxides, and aldehydes were calculated from values found in U.S.EPA AP-42, "Compilation of Pollutant Emission Factors", Volume II, Section II-7 (Heavy Construction Equipment).

(5) Thermal releases were based on the assumption that diesel engines lose 75% of their working energy through thermal releases, and that gasoline engines lose 80% through thermal releases. Also, diesel has 140,000 Btu/gal, and gasol has 127,850 Btu/gal (1055.1 J/Btu).

(6) The water tanker is assumed to run 4 hours each day for the duration of construction; the fuel/lube truck is assumed to run 3 hours each day for the duration of construction.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

BACKUP FOR EMISSIONS CALCULATIONS

SCHEDULE IN DAYS FOR EACH BARRIER LAYER

BARRIER LAYER	SCHEDULE: TANK FARMS	SCHEDULE: EPT OPT B	SCHEDULE: EPT OPT A	SCHEDULE: TPA GLASS
Site Grading	252.26	2202.80	421.52	405.05
Base Course	8.76	23.05	11.46	11.31
Asphalt	43.08	157.17	61.87	60.74
Top Coating	215.70	786.20	309.60	304.00
Drainage Layer	25.14	63.82	32.55	32.17
Basalt	2406.98	5569.78	3051.25	3021.66
Filter Layers	68.19	225.07	94.83	93.43
Lower Silt	585.02	2102.53	836.13	821.35
Upper Silt	592.00	2033.38	834.58	820.48
Road Base	1.53	4.63	1.77	1.74
TOTAL DAYS:	4198.66	13186.63	5655.71	5571.82

EQUIPMENT USAGE FOR EACH BARRIER LAYER

BARRIER LAYER	D8 DOZER (hours per day for each layer)	BACKHOE (hours per day for each layer)	COMPACTOR (hours per day for each layer)	GRADER (hours per day for each layer)	LOADER (hours per day for each layer)	DUMP TRUCKS (hours per day for each layer)
Site Grading	8		4	8	4	40
Base Course		8	4		4	40
Asphalt			4			32
Top Coating						16
Drainage Layer		8	4	8	4	40
Basalt	8				4	40
Gravel Filter		8	4	8	4	40
Lower Silt		4			4	40
Upper Silt		4			4	40
Road Base			4	4	4	16
HOURS USAGE/BARRIER	16	32	24	28	32	344

EQUIPMENT USAGE FOR EACH BARRIER LAYER (TANK FARMS)

BARRIER LAYER	D8 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	2018.08		1009.04	2018.08	1009.04	10090.4
Base Course		70.08	35.04		35.04	350.4
Asphalt			172.32			1378.56
Top Coating						3451.2
Drainage Layer		201.12	100.56	201.12	100.56	1005.6
Basalt	19255.84				9627.92	96279.2
Gravel Filter		545.52	272.76	545.52	272.76	2727.6
Lower Silt		2340.08			2340.08	23400.8
Upper Silt		2368			2368	23680
Road Base			6.12	6.12	6.12	24.48
HOURS USAGE/BARRIER	21273.92	5524.8	1595.84	2770.84	15759.52	162388.24

EQUIPMENT USAGE FOR EACH BARRIER LAYER (EXTENSIVE PRETREATMENT: OPTION B)

BARRIER LAYER	D8 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	17622.4		8811.2	17622.4	8811.2	88112
Base Course		184.4	92.2		92.2	922
Asphalt			628.68			5029.44
Top Coating						12579.2
Drainage Layer		510.56	255.28	510.56	255.28	2552.8
Basalt	44558.24				22279.12	222791.2
Gravel Filter		1800.56	900.28	1800.56	900.28	9002.8
Lower Silt		8410.12			8410.12	84101.2
Upper Silt		8133.52			8133.52	81335.2
Road Base			8.36	8.36	8.36	33.44
HOURS USAGE/BARRIER	62180.64	19039.16	10696	19941.88	46890.08	506459.28

EQUIPMENT USAGE FOR EACH BARRIER LAYER (EXTENSIVE PRETREATMENT: OPTION A)

BARRIER LAYER	D8 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	3372.16		1686.08	3372.16	1686.08	16860.8
Base Course		91.68	45.84		45.84	458.4
Asphalt			247.48			1979.84
Top Coating						4953.6
Drainage Layer		260.4	130.2	260.4	130.2	1302
Basalt	24410				12205	122050
Gravel Filter		758.64	379.32	758.64	379.32	3793.2
Lower Silt		3344.52			3344.52	33445.2
Upper Silt		3338.32			3338.32	33383.2
Road Base			7.08	7.08	7.08	28.32
HOURS USAGE/BARRIER	27782.16	7794.76	2496.6	4399.48	21136.96	218260.56

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

EQUIPMENT USAGE FOR EACH BARRIER LAYER (TPA CLASS)

BARRIER LAYER	D8 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	3240.4		1620.2	3240.4	1620.2	16202
Base Course		90.48	45.24		45.24	452.4
Asphalt			242.96			1943.68
Top Coating						4864
Drainage Layer		257.36	128.68	257.36	128.68	1286.8
Basalt	24172.4				12086.2	120862
Gravel Filter		747.44	373.72	747.44	373.72	3737.2
Lower Silt		3285.4			3285.4	32854
Upper Silt		3281.92			3281.92	32819.2
Road Base			6.96	6.96	6.96	27.84
HOURS USAGE/BARRIER	27412.8	7862.6	2417.76	4252.16	20828.32	215049.12

NOTE. These calculations assume a five day workweek consisting of 8-hour days

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

PAVED ROAD TRAFFIC PARTICULATE EMISSIONS

TANK FARM	BARRIER LAYER	VOLUME (cu yd)	VOLUME (cu m)	SILT LOAD (g/sq m)	NUMBER OF TRIPS	ROUND TRIP (miles)	ROUND TRIP (km)	EF (g/km)
A	Grading Fill	7500	5734.50	8	750	6	9.66	194.80
	Base Course	1600	1223.36	8	160	6	9.66	194.80
	Drainage Gravel	5400	4128.84	8	540	6	9.66	194.80
	Fractured Basalt	34300	26225.78	5	3430	38	61.15	169.18
	Filter Media	4400	3364.24	8	440	6	9.66	194.80
	Topsoil	16900	12921.74	20	1690	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
AX	Grading Fill	5200	3975.92	8	520	6	9.66	194.80
	Base Course	1300	993.98	8	130	6	9.66	194.80
	Drainage Gravel	4200	3211.32	8	420	6	9.66	194.80
	Fractured Basalt	27000	20644.20	5	2700	38	61.15	169.18
	Filter Media	3100	2370.26	8	310	6	9.66	194.80
	Topsoil	11700	8945.82	20	1170	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
B	Grading Fill	19800	15139.08	8	1980	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	10000	7646.00	8	1000	6	9.66	194.80
	Fractured Basalt	61200	46793.52	5	6120	38	61.15	169.18
	Filter Media	9800	7493.08	8	980	6	9.66	194.80
	Topsoil	39900	30507.54	20	3990	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
BX	Grading Fill	15400	11774.84	8	1540	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8500	6499.10	8	850	6	9.66	194.80
	Fractured Basalt	53000	40523.80	5	5300	38	61.15	169.18
	Filter Media	8000	6116.80	8	800	6	9.66	194.80
	Topsoil	31400	24008.44	20	3140	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
BY	Grading Fill	15600	11927.76	8	1560	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8600	6575.56	8	860	6	9.66	194.80
	Fractured Basalt	53600	40982.56	5	5360	38	61.15	169.18
	Filter Media	8200	6269.72	8	820	6	9.66	194.80
	Topsoil	31800	24314.28	20	3180	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
C	Grading Fill	20400	15597.84	8	2040	6	9.66	194.80
	Base Course	3200	2446.72	8	320	6	9.66	194.80
	Drainage Gravel	10200	7798.92	8	1020	6	9.66	194.80
	Fractured Basalt	62300	47634.58	5	6230	38	61.15	169.18
	Filter Media	10000	7646.00	8	1000	6	9.66	194.80
	Topsoil	40900	31272.14	20	4090	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
S	Grading Fill	15900	12157.14	8	1590	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8700	6652.02	8	870	6	9.66	194.80
	Fractured Basalt	54000	41288.40	5	5400	38	61.15	169.18
	Filter Media	8200	6269.72	8	820	6	9.66	194.80
	Topsoil	33200	25384.72	20	3320	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
SX	Grading Fill	20000	15292.00	8	2000	6	9.66	194.80
	Base Course	3200	2446.72	8	320	6	9.66	194.80
	Drainage Gravel	10400	7951.84	8	1040	6	9.66	194.80
	Fractured Basalt	63700	48705.02	5	6370	38	61.15	169.18
	Filter Media	10200	7798.92	8	1020	6	9.66	194.80
	Topsoil	41300	31577.98	20	4130	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
T	Grading Fill	19800	15139.08	8	1980	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	10000	7646.00	8	1000	6	9.66	194.80
	Fractured Basalt	61200	46793.52	5	6120	38	61.15	169.18
	Filter Media	9800	7493.08	8	980	6	9.66	194.80
	Topsoil	39900	30507.54	20	3990	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
TX	Grading Fill	28600	21867.56	8	2860	6	9.66	194.80
	Base Course	4000	3058.40	8	400	6	9.66	194.80
	Drainage Gravel	12800	9786.88	8	1280	6	9.66	194.80
	Fractured Basalt	77300	59103.58	5	7730	38	61.15	169.18
	Filter Media	13200	10092.72	8	1320	6	9.66	194.80
	Topsoil	54500	41670.70	20	5450	28	45.06	256.44
	Road Base	600	458.76	5	60	38	61.15	169.18
TY	Grading Fill	7600	5810.96	8	760	6	9.66	194.80
	Base Course	1700	1299.82	8	170	6	9.66	194.80
	Drainage Gravel	5400	4128.84	8	540	6	9.66	194.80
	Fractured Basalt	34600	26455.16	5	3460	38	61.15	169.18
	Filter Media	4400	3364.24	8	440	6	9.66	194.80
	Topsoil	17200	13151.12	20	1720	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

U	Grading Fill	19200	14680.32	8	1920	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	9800	7493.06	8	980	6	9.66	194.80
	Fractured Basalt	60100	45952.46	5	6010	38	61.15	169.18
	Filter Media	9600	7340.16	8	960	6	9.66	194.80
	Topsoil	38900	29742.94	20	3890	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
DST AN	Grading Fill	12500	9557.50	8	1250	6	9.66	194.80
	Base Course	2300	1758.58	8	230	6	9.66	194.80
	Drainage Gravel	7400	5658.04	8	740	6	9.66	194.80
	Fractured Basalt	46200	35324.52	5	4620	38	61.15	169.18
	Filter Media	6700	5122.82	8	670	6	9.66	194.80
	Topsoil	26800	20491.28	20	2680	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
DST AP	Grading Fill	10700	8181.22	8	1070	6	9.66	194.80
	Base Course	2200	1682.12	8	220	6	9.66	194.80
	Drainage Gravel	7000	5352.20	8	700	6	9.66	194.80
	Fractured Basalt	44100	33718.86	5	4410	38	61.15	169.18
	Filter Media	6100	4664.06	8	610	6	9.66	194.80
	Topsoil	24000	18350.40	20	2400	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
DST AW	Grading Fill	8000	6116.80	8	800	6	9.66	194.80
	Base Course	1700	1299.82	8	170	6	9.66	194.80
	Drainage Gravel	5600	4281.76	8	560	6	9.66	194.80
	Fractured Basalt	35800	27372.68	5	3580	38	61.15	169.18
	Filter Media	4600	3517.16	8	460	6	9.66	194.80
	Topsoil	18100	13839.26	20	1810	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
DST AY	Grading Fill	2900	2217.34	8	290	6	9.66	194.80
	Base Course	900	688.14	8	90	6	9.66	194.80
	Drainage Gravel	2900	2217.34	8	290	6	9.66	194.80
	Fractured Basalt	19300	14756.78	5	1930	38	61.15	169.18
	Filter Media	1800	1376.28	8	180	6	9.66	194.80
	Topsoil	6300	4816.98	20	630	28	45.06	256.44
	Road Base	200	152.92	5	20	38	61.15	169.18
DST AZ	Grading Fill	2900	2217.34	8	290	6	9.66	194.80
	Base Course	900	688.14	8	90	6	9.66	194.80
	Drainage Gravel	2900	2217.34	8	290	6	9.66	194.80
	Fractured Basalt	19300	14756.78	5	1930	38	61.15	169.18
	Filter Media	1800	1376.28	8	180	6	9.66	194.80
	Topsoil	6300	4816.98	20	630	28	45.06	256.44
	Road Base	200	152.92	5	20	38	61.15	169.18
DST SY	Grading Fill	5400	4128.84	8	540	6	9.66	194.80
	Base Course	1300	993.98	8	130	6	9.66	194.80
	Drainage Gravel	4300	3287.78	8	430	6	9.66	194.80
	Fractured Basalt	27600	21102.96	5	2760	38	61.15	169.18
	Filter Media	3200	2446.72	8	320	6	9.66	194.80
	Topsoil	12300	9404.58	20	1230	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
EPT OPTION B	Grading Fill	1835800	1403652.68	8	183580	6	9.66	194.80
	Base Course	67800	51839.88	8	6780	6	9.66	194.80
	Drainage Gravel	206300	157736.98	8	20630	6	9.66	194.80
	Fractured Basalt	1096700	838536.82	5	109670	38	61.15	169.18
	Filter Media	283400	216687.64	8	28340	6	9.66	194.80
	Topsoil	1239100	947415.86	20	123910	28	45.06	256.44
	Road Base	2600	1987.96	5	260	38	61.15	169.18
EPT OPTION A	Grading Fill	159300	121800.78	8	15930	6	9.66	194.80
	Base Course	12800	9786.88	8	1280	6	9.66	194.80
	Drainage Gravel	39500	30201.70	8	3950	6	9.66	194.80
	Fractured Basalt	223400	170811.64	5	22340	38	61.15	169.18
	Filter Media	48400	37006.64	8	4840	6	9.66	194.80
	Topsoil	206800	158119.28	20	20680	28	45.06	256.44
	Road Base	1100	841.06	5	110	38	61.15	169.18
TPA GLASS	Grading Fill	143800	109949.48	8	14380	6	9.66	194.80
	Base Course	12100	9251.66	8	1210	6	9.66	194.80
	Drainage Gravel	37500	28672.50	8	3750	6	9.66	194.80
	Fractured Basalt	213100	162936.26	5	21310	38	61.15	169.18
	Filter Media	45600	34865.76	8	4560	6	9.66	194.80
	Topsoil	194700	148867.62	20	19470	28	45.06	256.44
	Road Base	1000	764.60	5	100	38	61.15	169.18

NOTES:

(1) The silt load is the amount of silt on the paved road in grams per square meter.

(2) The emission factor is the amount of PM10 particles in grams/vehicle kilometer traveled. This factor was found by solving the equation: EF = 220*[(silt load)/12]^0.3

(3) The tonnes of dust emitted was found by multiplying the number of trips by the kilometers/trip by the EF, and then dividing by 10^6 grams/tonne

(4) This table was generated using equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

UNPAVED ROAD TRAFFIC PARTICULATE EMISSIONS

TANK FARM	BARRIER LAYER	VOLUME (yd^3)	VOLUME (m^3)	SILT LOAD (%)	NUMBER OF TRIPS	ROUND TRIP (miles)	ROUND TRIP (km)	EF (g/km)
A	Grading Fill	7500	5734.50	15	750	1	1.61	1108.84
	Base Course	1600	1223.36	15	160	1	1.61	1108.84
	Drainage Gravel	5400	4128.84	15	540	1	1.61	1108.84
	Fractured Basalt	34300	26225.78	12	3430	6	9.66	887.07
	Filter Media	4400	3364.24	15	440	1	1.61	1108.84
	Topsoil	16900	12921.74	18	1690	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
AX	Grading Fill	5200	3975.92	15	520	1	1.61	1108.84
	Base Course	1300	993.98	15	130	1	1.61	1108.84
	Drainage Gravel	4200	3211.32	15	420	1	1.61	1108.84
	Fractured Basalt	27000	20644.20	12	2700	6	9.66	887.07
	Filter Media	3100	2370.26	15	310	1	1.61	1108.84
	Topsoil	11700	8945.82	18	1170	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
B	Grading Fill	19800	15139.08	15	1980	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	10000	7646.00	15	1000	1	1.61	1108.84
	Fractured Basalt	61200	46793.52	12	6120	6	9.66	887.07
	Filter Media	9800	7493.08	15	980	1	1.61	1108.84
	Topsoil	39900	30507.54	18	3990	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
BX	Grading Fill	15400	11774.84	15	1540	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8500	6499.10	15	850	1	1.61	1108.84
	Fractured Basalt	53000	40523.80	12	5300	6	9.66	887.07
	Filter Media	8000	6116.80	15	800	1	1.61	1108.84
	Topsoil	31400	24008.44	18	3140	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
BY	Grading Fill	15600	11927.76	15	1560	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8600	6575.56	15	860	1	1.61	1108.84
	Fractured Basalt	53600	40982.56	12	5360	6	9.66	887.07
	Filter Media	8200	6269.72	15	820	1	1.61	1108.84
	Topsoil	31800	24314.28	18	3180	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
C	Grading Fill	20400	15597.84	15	2040	1	1.61	1108.84
	Base Course	3200	2446.72	15	320	1	1.61	1108.84
	Drainage Gravel	10200	7798.92	15	1020	1	1.61	1108.84
	Fractured Basalt	62300	47634.58	12	6230	6	9.66	887.07
	Filter Media	10000	7646.00	15	1000	1	1.61	1108.84
	Topsoil	40900	31272.14	18	4090	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
S	Grading Fill	15900	12157.14	15	1590	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8700	6652.02	15	870	1	1.61	1108.84
	Fractured Basalt	54000	41288.40	12	5400	6	9.66	887.07
	Filter Media	8200	6269.72	15	820	1	1.61	1108.84
	Topsoil	33200	25384.72	18	3320	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
SX	Grading Fill	20000	15292.00	15	2000	1	1.61	1108.84
	Base Course	3200	2446.72	15	320	1	1.61	1108.84
	Drainage Gravel	10400	7951.84	15	1040	1	1.61	1108.84
	Fractured Basalt	63700	48705.02	12	6370	6	9.66	887.07
	Filter Media	10200	7798.92	15	1020	1	1.61	1108.84
	Topsoil	41300	31577.98	18	4130	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
T	Grading Fill	19800	15139.08	15	1980	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	10000	7646.00	15	1000	1	1.61	1108.84
	Fractured Basalt	61200	46793.52	12	6120	6	9.66	887.07
	Filter Media	9800	7493.08	15	980	1	1.61	1108.84
	Topsoil	39900	30507.54	18	3990	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
TX	Grading Fill	28600	21867.56	15	2860	1	1.61	1108.84
	Base Course	4000	3058.40	15	400	1	1.61	1108.84
	Drainage Gravel	12800	9786.88	15	1280	1	1.61	1108.84
	Fractured Basalt	77300	59103.58	12	7730	6	9.66	887.07
	Filter Media	13200	10092.72	15	1320	1	1.61	1108.84
	Topsoil	54500	41670.70	18	5450	6	9.66	1330.61
	Road Base	600	458.76	15	60	6	9.66	1108.84
TY	Grading Fill	7600	5810.96	15	760	1	1.61	1108.84
	Base Course	1700	1299.82	15	170	1	1.61	1108.84
	Drainage Gravel	5400	4128.84	15	540	1	1.61	1108.84
	Fractured Basalt	34600	26455.16	12	3460	6	9.66	887.07
	Filter Media	4400	3364.24	15	440	1	1.61	1108.84
	Topsoil	17200	13151.12	18	1720	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84

Table A10. Nonradiological Barrier Construction Emissions (10 sheets).
(Backup to Table 5-4).

U	Grading Fill	19200	14680.32	15	1920	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	9800	7493.08	15	980	1	1.61	1108.84
	Fractured Basalt	60100	45952.46	12	6010	6	9.66	887.07
	Filter Media	9600	7340.16	15	960	1	1.61	1108.84
	Topsoil	38900	29742.94	18	3890	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
DST AN	Grading Fill	12500	9557.50	15	1250	1	1.61	1108.84
	Base Course	2300	1758.58	15	230	1	1.61	1108.84
	Drainage Gravel	7400	5658.04	15	740	1	1.61	1108.84
	Fractured Basalt	46200	35324.52	12	4620	6	9.66	887.07
	Filter Media	6700	5122.82	15	670	1	1.61	1108.84
	Topsoil	26800	20491.28	18	2680	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
DST AP	Grading Fill	10700	8181.22	15	1070	1	1.61	1108.84
	Base Course	2200	1682.12	15	220	1	1.61	1108.84
	Drainage Gravel	7000	5352.20	15	700	1	1.61	1108.84
	Fractured Basalt	44100	33718.86	12	4410	6	9.66	887.07
	Filter Media	6100	4664.06	15	610	1	1.61	1108.84
	Topsoil	24000	18350.40	18	2400	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
DST AW	Grading Fill	8000	6116.80	15	800	1	1.61	1108.84
	Base Course	1700	1299.82	15	170	1	1.61	1108.84
	Drainage Gravel	5600	4281.76	15	560	1	1.61	1108.84
	Fractured Basalt	35800	27372.68	12	3580	6	9.66	887.07
	Filter Media	4600	3517.16	15	460	1	1.61	1108.84
	Topsoil	18100	13839.26	18	1810	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
DST AY	Grading Fill	2900	2217.34	15	290	1	1.61	1108.84
	Base Course	900	688.14	15	90	1	1.61	1108.84
	Drainage Gravel	2900	2217.34	15	290	1	1.61	1108.84
	Fractured Basalt	19300	14756.78	12	1930	6	9.66	887.07
	Filter Media	1800	1376.28	15	180	1	1.61	1108.84
	Topsoil	6300	4816.98	18	630	6	9.66	1330.61
	Road Base	200	152.92	15	20	6	9.66	1108.84
DST AZ	Grading Fill	2900	2217.34	15	290	1	1.61	1108.84
	Base Course	900	688.14	15	90	1	1.61	1108.84
	Drainage Gravel	2900	2217.34	15	290	1	1.61	1108.84
	Fractured Basalt	19300	14756.78	12	1930	6	9.66	887.07
	Filter Media	1800	1376.28	15	180	1	1.61	1108.84
	Topsoil	6300	4816.98	18	630	6	9.66	1330.61
	Road Base	200	152.92	15	20	6	9.66	1108.84
DST SY	Grading Fill	5400	4128.84	15	540	1	1.61	1108.84
	Base Course	1300	993.98	15	130	1	1.61	1108.84
	Drainage Gravel	4300	3287.78	15	430	1	1.61	1108.84
	Fractured Basalt	27600	21102.96	12	2760	6	9.66	887.07
	Filter Media	3200	2446.72	15	320	1	1.61	1108.84
	Topsoil	12300	9404.58	18	1230	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
EPT OPT B	Grading Fill	1835800	1403652.68	15	183580	1	1.61	1108.84
	Base Course	67800	51839.88	15	6780	1	1.61	1108.84
	Drainage Gravel	206300	157736.98	15	20630	1	1.61	1108.84
	Fractured Basalt	1096700	838536.82	12	109670	6	9.66	887.07
	Filter Media	283400	216687.64	15	28340	1	1.61	1108.84
	Topsoil	1239100	947415.86	18	123910	6	9.66	1330.61
	Road Base	2600	1987.96	15	260	6	9.66	1108.84
EPT OPT A	Grading Fill	159300	121800.78	15	15930	1	1.61	1108.84
	Base Course	12800	9786.88	15	1280	1	1.61	1108.84
	Drainage Gravel	39500	30201.70	15	3950	1	1.61	1108.84
	Fractured Basalt	223400	170811.64	12	22340	6	9.66	887.07
	Filter Media	48400	37006.64	15	4840	1	1.61	1108.84
	Topsoil	206800	158119.28	18	20680	6	9.66	1330.61
	Road Base	1100	841.06	15	110	6	9.66	1108.84
TPA GLASS	Grading Fill	143800	109949.48	15	14380	1	1.61	1108.84
	Base Course	12100	9251.66	15	1210	1	1.61	1108.84
	Drainage Gravel	37500	28672.50	15	3750	1	1.61	1108.84
	Fractured Basalt	213100	162936.26	12	21310	6	9.66	887.07
	Filter Media	45600	34865.76	15	4560	1	1.61	1108.84
	Topsoil	194700	148867.62	18	19470	6	9.66	1330.61
	Road Base	1000	764.60	15	100	6	9.66	1108.84

NOTES.

(1) The mean vehicle speed, S, is estimated at 40.2 km/hr (25 mph)

(2) The mean vehicle weight, W is estimated at 33.66 Mg, the mean number of wheels/vehicle, w, is assumed to be 18

(3) The number of days with > 0.01 inches of precipitation, p, is assumed to be 90

(4) The control efficiency of road watering, c, is assumed to be 81.5%

(5) The PM10 Emission Factor is found from the equation EF = 610*(s/12)*(S/48)*((W/2.7)^0.7)*((w/4)^0.5)*(365 - p/365)*(100 - c/

(6) The total mass of dust emitted is calculated by the number of trips*distance/round trip*emission factor; this number is divided by 10^6 to get the mass in tonnes

(7) This table was generated using the equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

FUGITIVE DUST EMISSIONS FROM MATERIAL TRANSFERS FOR BARRIER CONSTRUCTION

TANK FARM	BARRIER LAYER	# OF TRANSFERS	FROM WHERE	K	U (m/sec)	X H2O (%)	M (kg)	EF (tonne)
SSTs	Grading Fill	4	Pit 30	0.35	5.68	3	2.86E+08	1.25
	Base Course	4	Pit 30	0.35	5.68	3	4.77E+07	0.21
	Drainage Gravel	4	Pit 30	0.35	5.68	3	1.50E+08	0.65
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	9.91E+08	7.62
	Filter Media	4	Pit 30	0.35	5.68	3	1.43E+08	0.62
	Topsoil	4	McGee Ranch	0.35	5.68	8	4.30E+08	0.47
	Road Base	3	Vernita Quarry	0.35	5.68	3	8.18E+06	0.04
DSTs	Grading Fill	4	Pit 30	0.35	5.68	3	6.24E+07	0.27
	Base Course	4	Pit 30	0.35	5.68	3	1.35E+07	0.06
	Drainage Gravel	4	Pit 30	0.35	5.68	3	4.36E+07	0.19
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	2.97E+08	2.28
	Filter Media	4	Pit 30	0.35	5.68	3	3.50E+07	0.15
	Topsoil	4	McGee Ranch	0.35	5.68	8	1.01E+08	0.11
	Road Base	3	Vernita Quarry	0.35	5.68	3	2.92E+06	0.01
EPT Opt B	Grading Fill	4	Pit 30	0.35	5.68	3	2.70E+09	11.76
	Base Course	4	Pit 30	0.35	5.68	3	9.96E+07	0.43
	Drainage Gravel	4	Pit 30	0.35	5.68	3	2.98E+08	1.30
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	1.69E+09	12.99
	Filter Media	4	Pit 30	0.35	5.68	3	4.09E+08	1.78
	Topsoil	4	McGee Ranch	0.35	5.68	8	1.34E+09	1.48
	Road Base	3	Vernita Quarry	0.35	5.68	3	3.99E+06	0.02
EPT Opt A	Grading Fill	4	Pit 30	0.35	5.68	3	2.34E+08	1.02
	Base Course	4	Pit 30	0.35	5.68	3	1.87E+07	0.08
	Drainage Gravel	4	Pit 30	0.35	5.68	3	5.71E+07	0.25
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	3.45E+08	2.65
	Filter Media	4	Pit 30	0.35	5.68	3	6.99E+07	0.30
	Topsoil	4	McGee Ranch	0.35	5.68	8	2.23E+08	0.25
	Road Base	3	Vernita Quarry	0.35	5.68	3	1.63E+06	0.01
TPA Glass	Grading Fill	4	Pit 30	0.35	5.68	3	2.11E+08	0.92
	Base Course	4	Pit 30	0.35	5.68	3	1.77E+07	0.08
	Drainage Gravel	4	Pit 30	0.35	5.68	3	5.42E+07	0.24
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	3.29E+08	2.53
	Filter Media	4	Pit 30	0.35	5.68	3	6.59E+07	0.29
	Topsoil	4	McGee Ranch	0.35	5.68	8	2.09E+08	0.23
	Road Base	3	Vernita Quarry	0.35	5.68	3	1.60E+06	0.01

NOTES:

(1) The four transfers for Grading Fill include (1) excavation and loading into trucks; (2) using the grizzly to eliminate oversized material; (3) transfer the material into trucks; and (4) hauling and placing.

(2) The four transfers for Base Course include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(3) The four transfers for Drainage Gravel include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(4) The four transfers for Fractured Basalt include (1) excavation and loading into trucks; (2) using the grizzly to eliminate oversized material; (3) transfer the material into trucks; and (4) hauling and placing.

(5) The four transfers for Filter Media include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(6) The four transfers for Topsoil include (1) excavation and loading into trucks; (2) stockpile the material at Pit 30; (3) transfer the material into trucks; and (4) hauling and placing.

(7) The three transfers for Road Base include (1) screening to specifications; (2) transfer the materials into trucks; and (3) hauling and placing.

(8) K is a particle size multiplier that is specific to PM10 (less than 10 micron) particles. It is unitless

(9) M is the mass of barrier material handled, in kg

(10) U is the mean wind speed, assumed to be 5.68 m/sec.

(11) X H2O is the percentage of moisture content in the soil.

(12) The emissions from transfer operations follows the equation: E = K*0.0016*M*[(U/2.2)^1.3]/[(X H2O/2)^1.4]. This gives the emissions in grams, which have been converted to kg by dividing by 1000.

(13) This table was generated using the equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

CLEARING AND GRUBBING EMISSIONS (BASED ON DAYS OF DOZER OPERATION)

TANK FARM	AREA (acres)	TIME (days)	EMISSIONS (tonne)
A	1.12	7.97	0.07
AX	0.73	5.53	0.05
B	3.00	21.04	0.18
BY	2.41	16.58	0.14
BX	2.37	16.36	0.14
C	3.08	21.68	0.19
S	2.44	16.89	0.15
SX	3.09	21.25	0.18
T	3.00	21.04	0.18
TY	1.13	8.06	0.07
TX	4.22	30.39	0.26
U	2.91	20.40	0.18
TOTAL:			1.79

AN	1.92	13.28	0.11
AP	1.65	11.37	0.10
AW	1.21	8.50	0.07
AY	0.31	3.08	0.03
AZ	0.31	3.08	0.03
SY	0.76	5.74	0.05
TOTAL:			0.39

EPT GROUT	16.46	152.79	2.82
EPT GLASS	17.56	169.26	3.12
TPA GLASS	111.03	1950.54	35.95

NOTES:

(1) For both the SSTs and the DSTs, the silt content is assumed to be 6%, and the soil moisture content is assumed to be 3%.

(2) For the LLW Vaults, the silt content is assumed to be 10%, and the soil moisture content is assumed to be 3%.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

DOZER GRADING EMISSIONS

TANK FARM	ASPHALT (acres)	ASPHALT (days)	ASPHALT (tonnes)	DRAINAGE (acres)	DRAINAGE (days)	DRAINAGE (tonnes)	BASALT (acres)	BASALT (days)	BASALT (tonnes)
A	1.12	0.34	0.001	1.12	1.01	0.004	1.12	98.92	0.71
AX	0.73	0.27	0.001	0.73	0.79	0.003	0.73	77.87	0.56
B	3.00	0.65	0.003	3.00	1.88	0.008	3.00	178.50	1.28
BY	2.41	0.57	0.002	2.41	1.61	0.007	2.41	154.58	1.12
BX	2.37	0.57	0.002	2.37	1.59	0.007	2.37	152.85	1.11
C	3.06	0.67	0.003	3.06	1.91	0.008	3.06	179.67	1.30
S	2.44	0.57	0.002	2.44	1.63	0.007	2.44	155.73	1.13
SX	3.09	0.67	0.003	3.09	1.95	0.008	3.09	183.71	1.33
T	3.00	0.65	0.003	3.00	1.88	0.008	3.00	178.50	1.28
TY	1.13	0.36	0.001	1.13	1.01	0.004	1.13	99.78	0.72
TX	4.22	0.84	0.003	4.22	2.40	0.010	4.22	222.93	1.61
U	2.91	0.65	0.003	2.91	1.84	0.008	2.91	173.36	1.25
SUBTOTAL SST:	29.50	6.81	0.027	29.50	19.50	0.082	29.50	1852.40	13.40
AN	1.92	0.48	0.002	1.92	1.39	0.006	1.92	133.24	0.96
AP	1.65	0.46	0.002	1.65	1.31	0.005	1.65	127.18	0.92
AW	1.21	0.36	0.001	1.21	1.05	0.004	1.21	103.24	0.75
AY	0.31	0.19	0.001	0.31	0.54	0.002	0.31	55.66	0.40
AZ	0.31	0.19	0.001	0.31	0.54	0.002	0.31	55.66	0.40
SY	0.76	0.27	0.001	0.76	0.81	0.003	0.76	79.60	0.58
SUBTOTAL DST:	6.16	1.95	0.008	6.16	5.64	0.022	6.16	2406.98	4.01
TOTAL TANKS:	35.66	8.76	0.035	35.66	25.14	0.104	35.66	4259.38	17.410

TANK FARM	FILTER (acres)	FILTER (days)	FILTER (tonnes)	TOPSOIL (acres)	TOPSOIL (days)	TOPSOIL (tonnes)	ROAD (acres)	ROAD (days)	ROAD (tonnes)
A	1.12	2.44	0.010	1.12	40.29	2.43	1.12	0.06	<0.001
AX	0.73	1.72	0.007	0.73	27.89	1.68	0.73	0.06	<0.001
B	3.00	5.43	0.022	3.00	95.20	5.75	3.00	0.11	<0.001
BY	2.41	4.54	0.045	2.41	78.25	4.72	2.41	0.09	<0.001
BX	2.37	4.43	0.018	2.37	77.29	4.67	2.37	0.09	<0.001
C	3.06	5.54	0.023	3.06	97.58	5.89	3.08	0.11	<0.001
S	2.44	4.54	0.019	2.44	79.21	4.78	2.44	0.11	<0.001
SX	3.09	5.65	0.023	3.09	98.55	5.95	3.09	0.11	<0.001
T	3.00	5.43	0.022	3.00	95.20	5.75	3.00	0.11	<0.001
TY	1.13	2.44	0.010	1.13	41.02	2.48	1.13	0.06	<0.001
TX	4.22	7.31	0.030	4.22	130.05	7.85	4.22	0.13	<0.001
U	2.91	5.31	0.022	2.91	92.61	5.60	2.91	0.11	<0.001
SUBTOTAL SST:	29.50	54.78	0.251	29.50	953.34	57.55	29.50	1.15	<0.010
AN	1.92	3.71	0.015	1.92	63.93	3.86	1.92	0.09	<0.001
AP	1.65	3.38	0.014	1.65	57.25	3.46	1.65	0.09	<0.001
AW	1.21	2.55	0.010	1.21	43.16	2.61	1.21	0.06	<0.001
AY	0.31	1.00	0.004	0.31	15.01	0.91	0.31	0.04	<0.001
AZ	0.31	1.00	0.004	0.31	15.01	0.91	0.31	0.04	<0.001
SY	0.76	1.77	0.007	0.76	29.32	1.77	0.76	0.06	<0.001
SUBTOTAL DST:	6.16	13.41	0.054	6.16	223.68	13.52	6.16	0.38	<0.005
TOTAL TANKS:	35.66	68.19	0.305	35.66	1177.02	71.07	35.66	1.53	<0.020

LLW VAULTS	ASPHALT (acres)	ASPHALT (days)	ASPHALT (tonnes)	DRAINAGE (acres)	DRAINAGE (days)	DRAINAGE (tonnes)	BASALT (acres)	BASALT (days)	BASALT (tonnes)
EPT GROUT	111.03	14.29	0.059	111.03	38.68	0.159	111.03	3162.80	22.89
EPT GLASS	17.56	2.70	0.011	17.56	7.41	0.030	17.56	644.27	4.66
TPA GLASS	16.46	2.55	0.010	16.46	7.03	0.029	16.46	614.57	4.45

LLW VAULTS	FILTER (acres)	FILTER (days)	FILTER (tonnes)	TOPSOIL (acres)	TOPSOIL (days)	TOPSOIL (tonnes)	ROAD (acres)	ROAD (days)	ROAD (tonnes)
EPT GROUT	111.03	156.88	0.644	111.03	2958.89	178.62	111.03	0.56	0.002
EPT GLASS	17.56	26.79	0.110	17.56	493.69	29.80	17.56	0.24	0.001
TPA GLASS	16.46	25.24	0.104	16.46	464.81	28.06	16.46	0.21	0.001

NOTE

(1) The barrier layers are assumed to all consist of 5% silt, except for the topsoil layer, which consists of 75% silt.

(2) The soil moisture content is assumed to be 3% in the asphalt base course, the drainage layer, the graded filter layer, and the road base. It is assumed to be 2% in the basalt layer, and 8% in the topsoil layers.

(3) All emissions calculations were based on EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at *Superfund Sites*," Report ASF-32.

Table A11. Barrier Cost by Component (1994 Dollars)
(Backup for Table 5-1, 5-2D, 5-8 and 5-9).

BACKUP FOR BARRIER COST BY COMPONENT
(IN 1994 DOLLARS)

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U
Def Design	128,328	98,238	247,428	209,904	212,377	252,430	214,456	256,908	247,428	320,621	129,580	242,285
Eng/Inspect	256,652	196,475	494,856	419,809	424,754	504,860	428,912	513,815	494,856	641,242	259,160	484,571
SRDI Test	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759
ENG-SUBTOTAL	444,737	354,472	802,043	689,472	696,890	817,049	703,127	830,482	802,043	1,021,622	448,499	786,615
Site Work	76,577	58,706	172,758	138,295	140,182	177,304	142,070	174,752	172,758	241,596	77,322	167,975
Base Course	43,853	33,757	83,514	71,072	71,897	85,173	72,587	86,743	83,514	107,759	44,274	81,810
Asphalt	1,096,842	844,178	2,088,454	1,777,317	1,797,943	2,129,938	1,815,190	2,169,204	2,088,454	2,694,759	1,107,182	2,045,832
Drain Gravel	91,837	71,480	170,807	146,155	147,801	174,096	149,167	177,408	170,807	218,831	92,886	167,430
Basalt	1,202,708	945,832	2,147,732	1,858,531	1,878,404	2,188,453	1,894,407	2,234,904	2,147,732	2,710,535	1,213,411	2,108,115
Gravel Filter	48,891	34,881	109,292	89,737	90,975	111,885	92,061	113,354	109,292	147,481	49,475	106,813
Sand Filter	32,381	22,989	73,108	59,898	60,735	74,859	61,468	75,812	73,108	98,895	32,772	71,298
Geotextile	25,329	17,983	57,188	46,853	47,505	58,556	48,079	59,301	57,188	77,357	25,635	55,770
Lower Silt	140,791	97,030	337,469	272,967	276,972	346,007	280,559	349,531	337,469	463,456	142,814	328,834
Upper Silt	175,202	122,872	405,196	330,282	334,981	415,123	339,145	420,028	405,196	551,489	177,382	394,934
Road	9,378	7,883	13,600	12,463	12,558	13,759	12,818	14,207	13,600	15,798	9,440	13,444
CON SUBTOTAL	2,943,589	2,257,571	5,659,114	4,803,570	4,859,948	5,773,150	4,907,349	5,875,242	5,659,114	7,327,914	2,972,173	5,541,855
TOTAL	3,388,326	2,612,043	6,461,157	5,493,042	5,556,838	6,590,199	5,610,476	6,705,724	6,461,157	8,349,536	3,420,672	6,328,470

MATERIAL	DST AN	DST AP	DST AW	DST AY	DST AZ	DST SY	EX PRE OPT B	EX PRE OPT A	TPA GLASS	TOTALS
Def Design	180,430	168,913	134,841	66,730	66,730	100,770	5,858,899	1,038,855	983,434	11,157,583
Eng/Inspect	360,860	337,825	269,683	133,460	133,460	201,540	11,713,798	2,077,709	1,966,867	22,315,164
SRDI Test	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	1,254,939
ENG SUBTOTAL	601,049	566,497	464,283	259,949	259,949	362,069	17,630,456	3,176,323	3,010,060	34,727,686
Site Work	115,947	101,290	80,757	40,402	40,402	60,224	14,400,406	1,285,455	1,144,522	18,989,896
Base Course	61,239	57,465	46,036	23,178	23,178	34,607	1,810,910	340,763	323,395	3,586,724
Asphalt	1,531,415	1,437,029	1,151,228	579,620	579,620	885,423	45,265,770	8,521,531	8,087,188	89,693,895
Drain Gravel	128,527	119,274	98,224	50,124	50,124	73,174	3,528,642	675,589	641,877	7,140,040
Basalt	1,621,323	1,546,969	1,257,165	677,616	677,616	987,401	50,682,065	7,835,875	7,473,781	95,248,595
Gravel Filter	75,005	67,954	52,009	20,118	20,118	38,084	3,145,201	537,960	507,183	5,565,529
Sand Filter	49,974	45,167	34,475	13,090	13,090	23,783	2,136,698	363,657	342,727	3,759,982
Geotextile	39,090	35,330	28,967	10,239	10,239	18,603	1,671,353	284,457	268,086	2,941,104
Lower Silt	225,328	200,592	150,661	50,800	50,800	100,731	10,776,043	1,783,667	1,677,545	18,369,684
Upper Silt	274,365	246,546	186,919	67,667	67,667	127,293	12,268,394	2,065,082	1,944,852	21,320,393
Road	11,341	11,341	9,574	6,340	6,340	8,007	72,454	29,599	29,084	332,824
CON SUBTOTAL	4,131,552	3,868,957	3,092,133	1,539,194	1,539,194	2,315,310	133,555,045	23,703,635	22,440,040	254,765,649
TOTAL	4,732,601	4,435,454	3,556,416	1,799,143	1,799,143	2,677,379	151,185,501	26,879,958	25,450,100	289,493,335

NOTE.

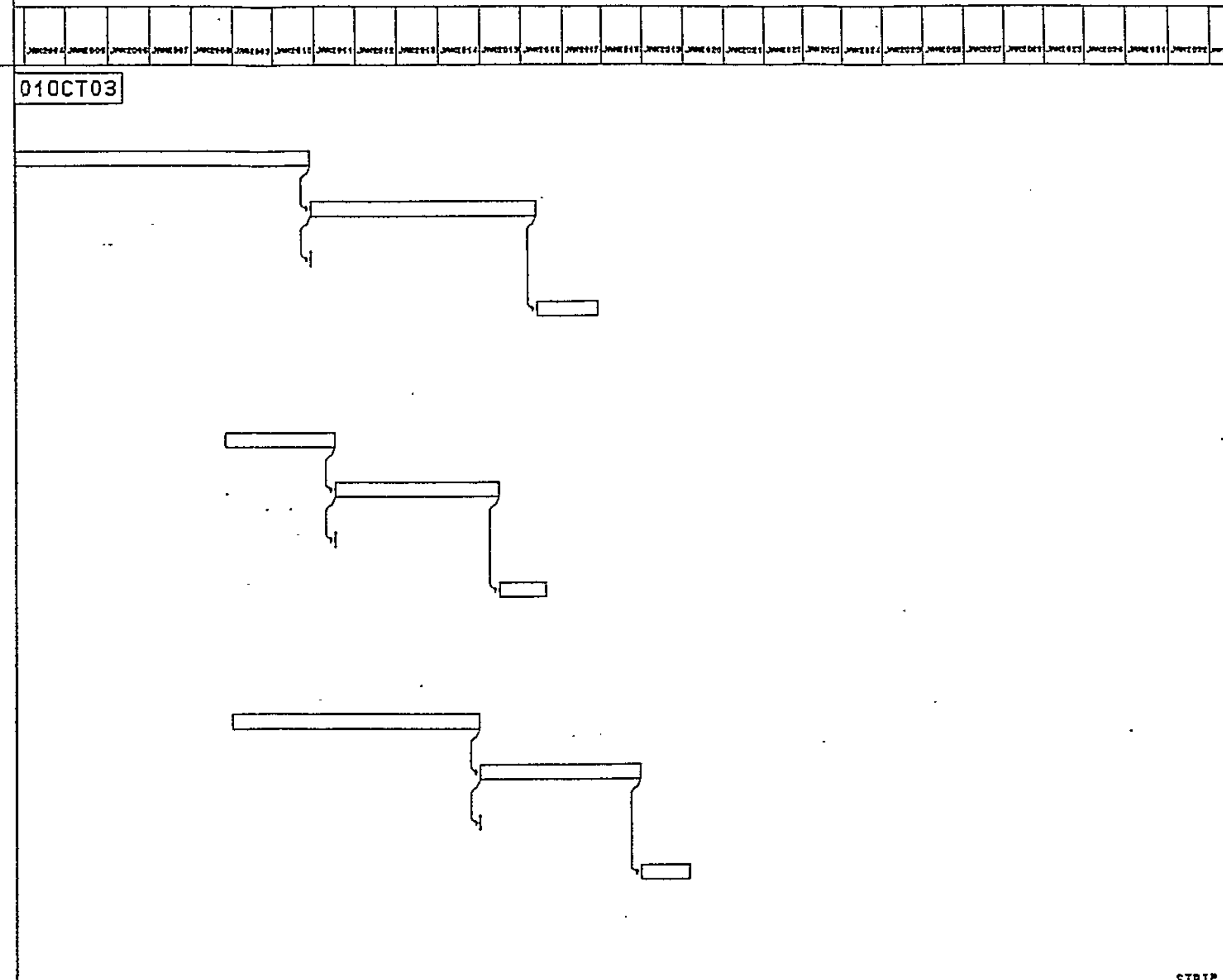
(1) The above design and construction costs are 1993 dollars escalated by a 2.9% inflation factor, and include a 15% contingency.

(2) The costs for EPT Option A, EPT Option B, and TPA Glass do not include the costs for barriers over the tank farms; they are strictly the costs of the barriers over the LLW Vaults

Tank Farm Retrieval Sequence
SST/DST Stabilization by Grout

Table A12-A. Schedule for Closure, Tank Stabilization by Grout (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
TX-Retrieval	1950 D
TXgrout	1512 D
TXppu	2 D
TXbarrier	423 D
U-Retrieval	750 D
Ugrout	1092 D
Uppu	2 D
Ubarrier	315 D
C-Retrieval	1664 D
Cgrout	1092 D
Cppu	1 D
Cbarrier	329 D



STRIP 1

Table A12-A. Schedule for Closure, Tank Stabilization by Grout (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
SX-Retrieval	750 D
SXgrout	1575 D
SXppu	1 D
SXbarrier	334 D
BY-Retrieval	1700 D
BYgrout	1008 D
BYppu	1 D
BYbarrier	273 D
S-Retrieval	1900 D
Sgrout	1008 D
Sppu	1 D
Sbarrier	276 D

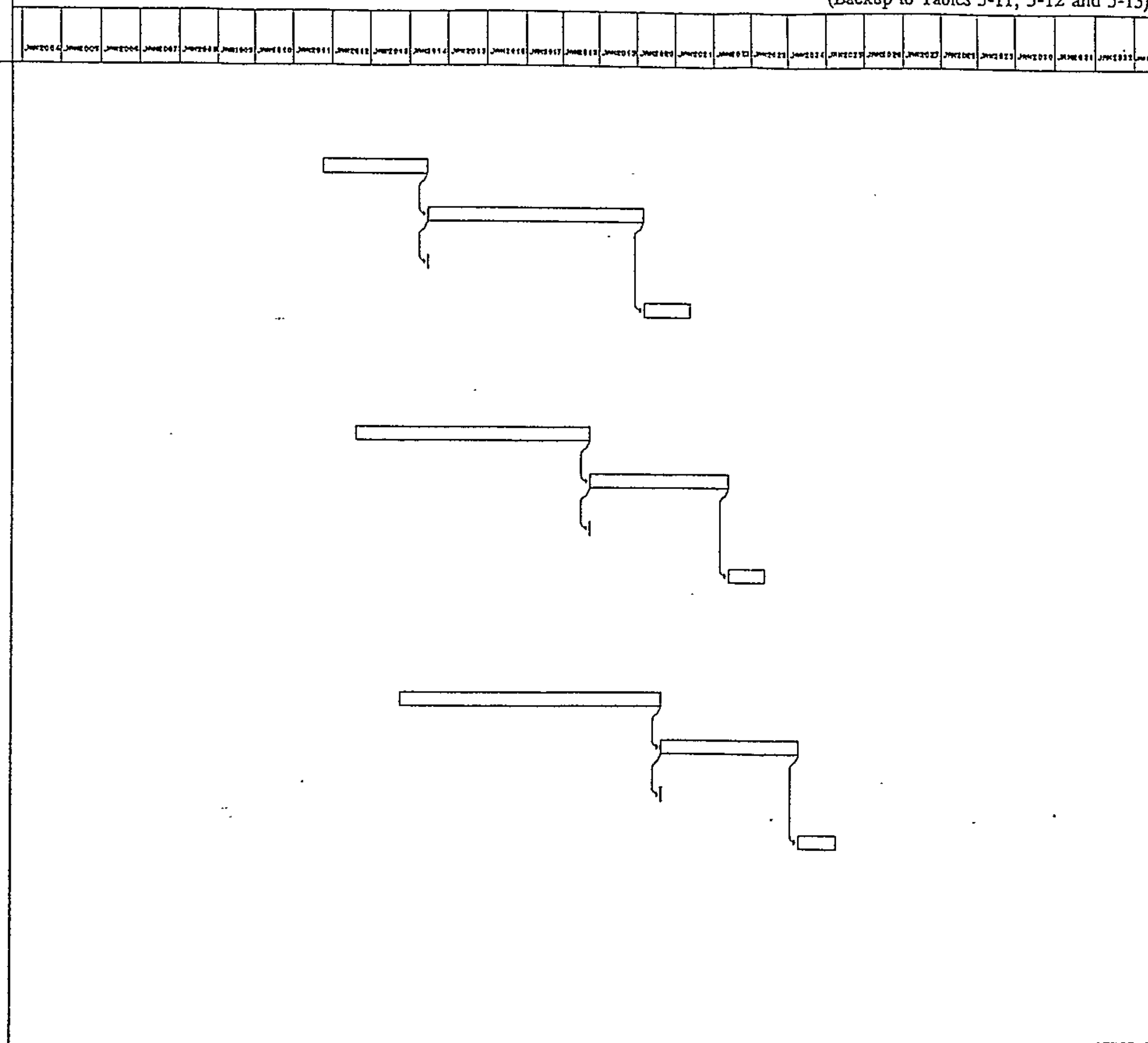


Table A12-A. Schedule for Closure, Tank Stabilization by Grout (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
T-Retrieval	1450 D
Tgrout	1092 D
Tppu	1 D
Tbarrier	322 D
B-Retrieval	1000 D
Bgrout	1092 D
Bppu	1 D
Bbarrier	322 D
BX-Retrieval	450 D
BXgrout	840 D
BXppu	1 D
BXbarrier	270 D

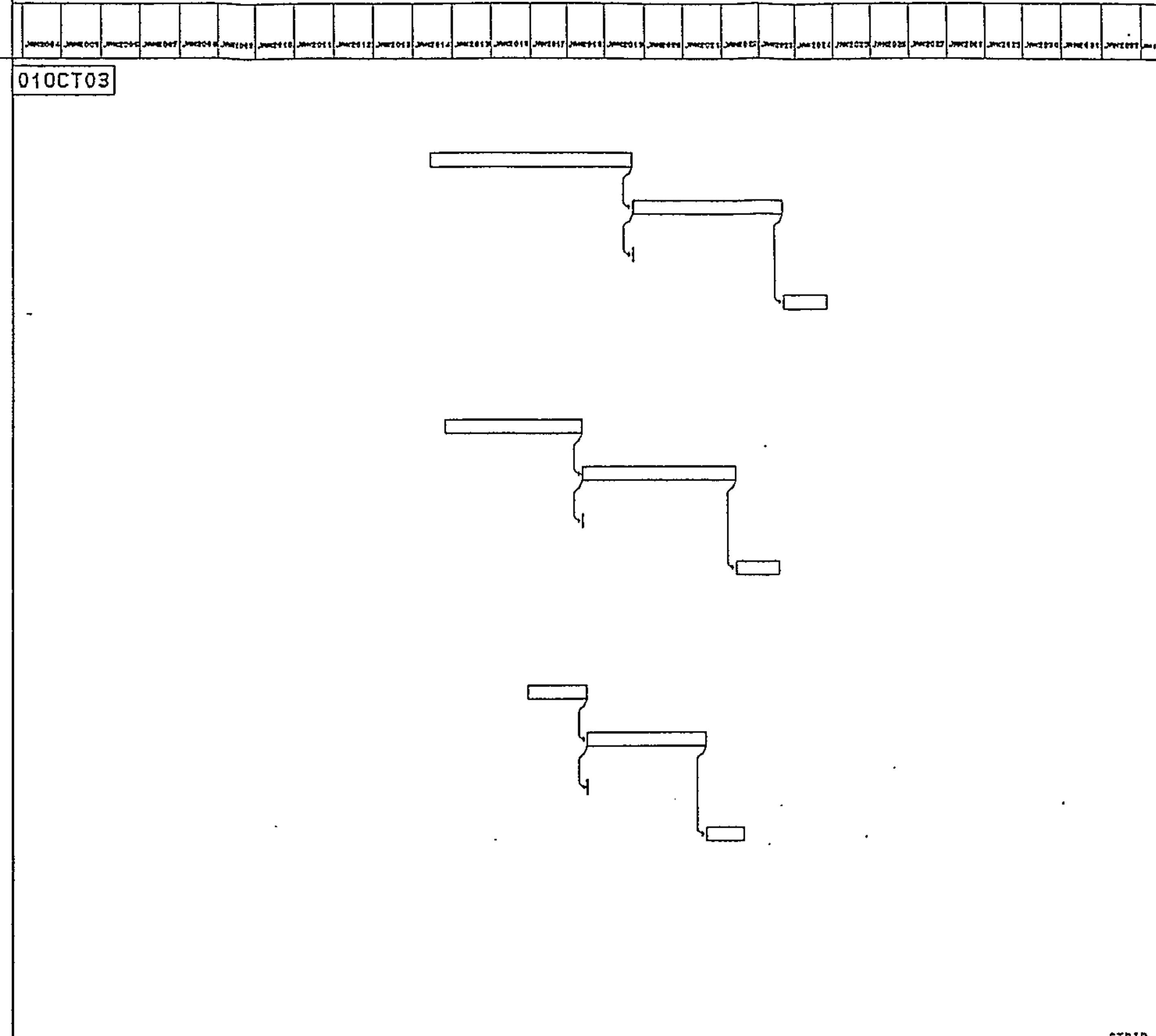
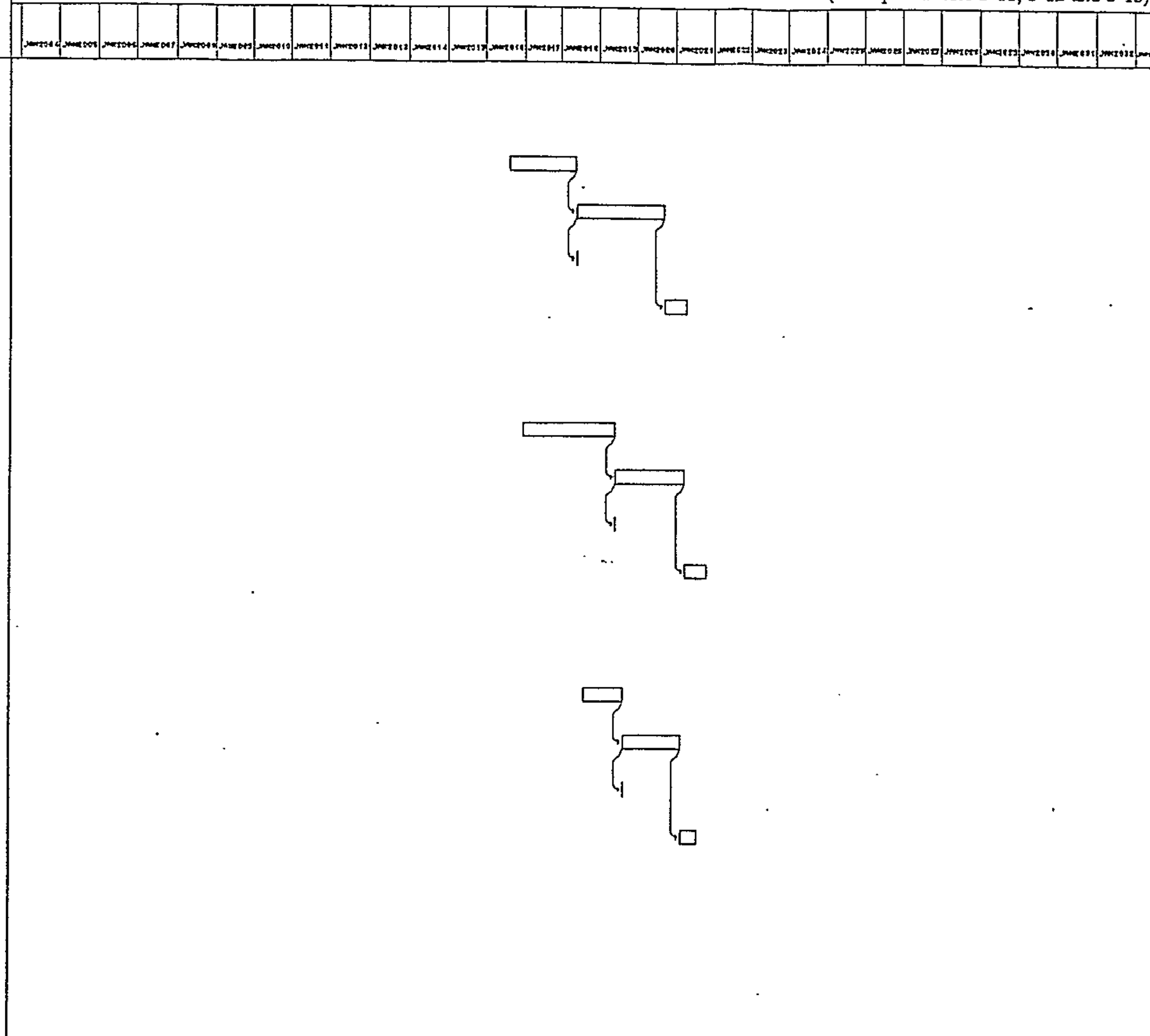


Table A12-A. Schedule for Closure, Tank Stabilization by Grout (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
A-Retrieval	500 D
Agrout	630 D
Appu	3 D
Abarrier	160 D
TY-Retrieval	675 D
TYgrout	504 D
TYppu	1 D
TYbarrier	162 D
AX-Retrieval	275 D
AXgrout	420 D
AXppu	2 D
AXbarrier	120 D



STRIP 4

Table A12-A. Schedule for Closure, Tank Stabilization by Grout (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
DSTanks	3842 D
DSTgrout	3108 D
DSTbarrier	893 D

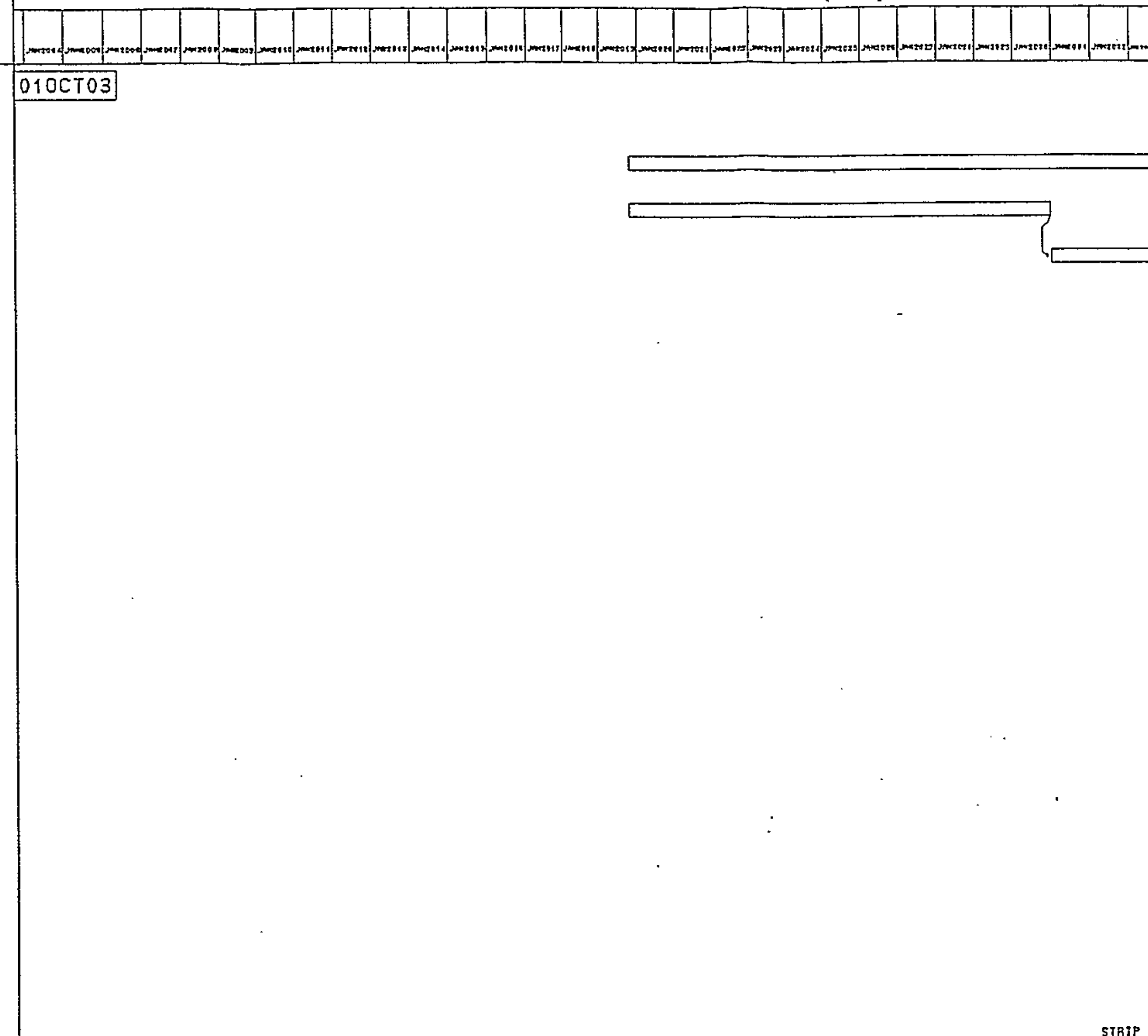


Table A12-B. Schedule for Tank Closure, Stabilization by Gravel (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

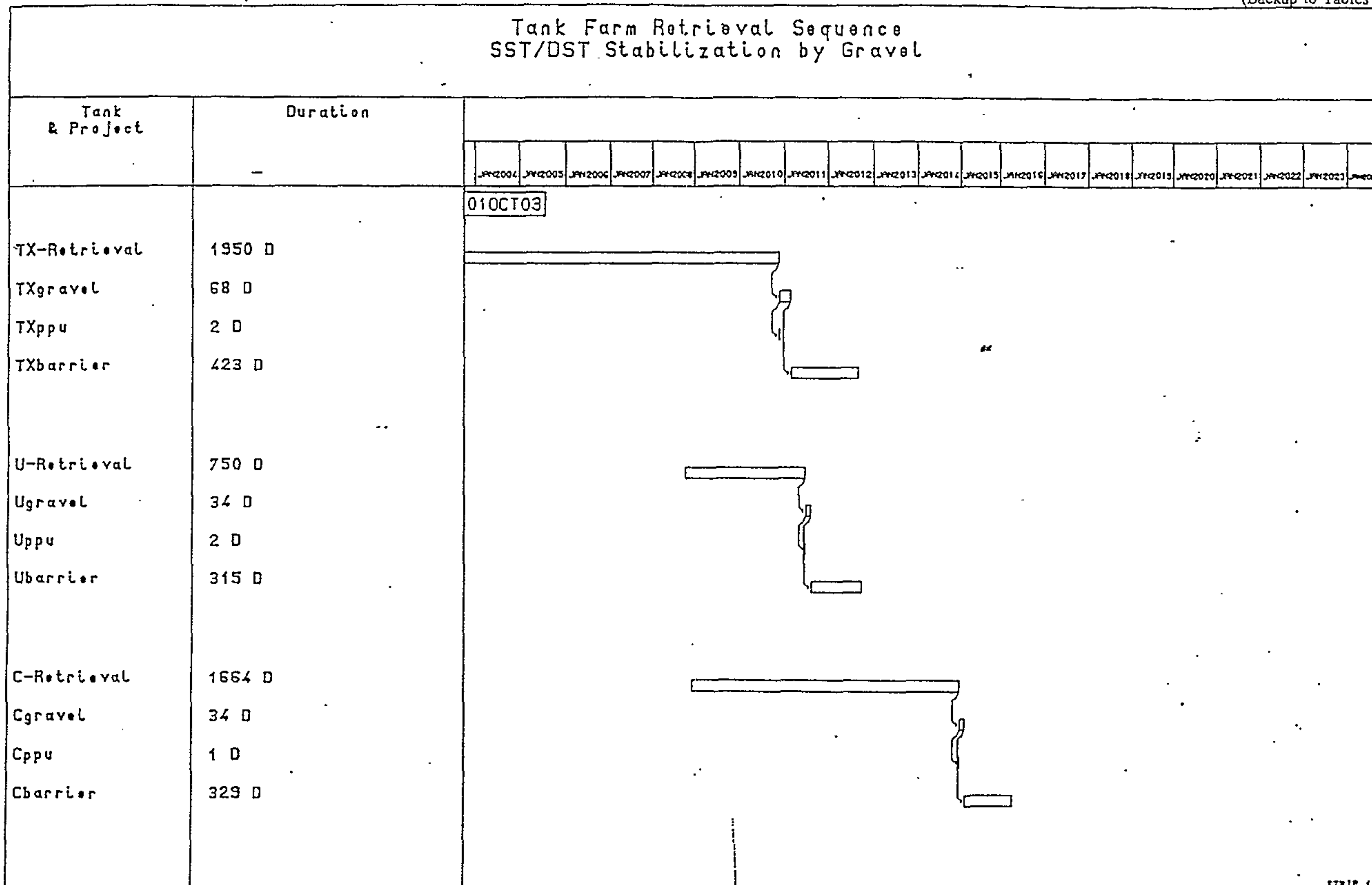
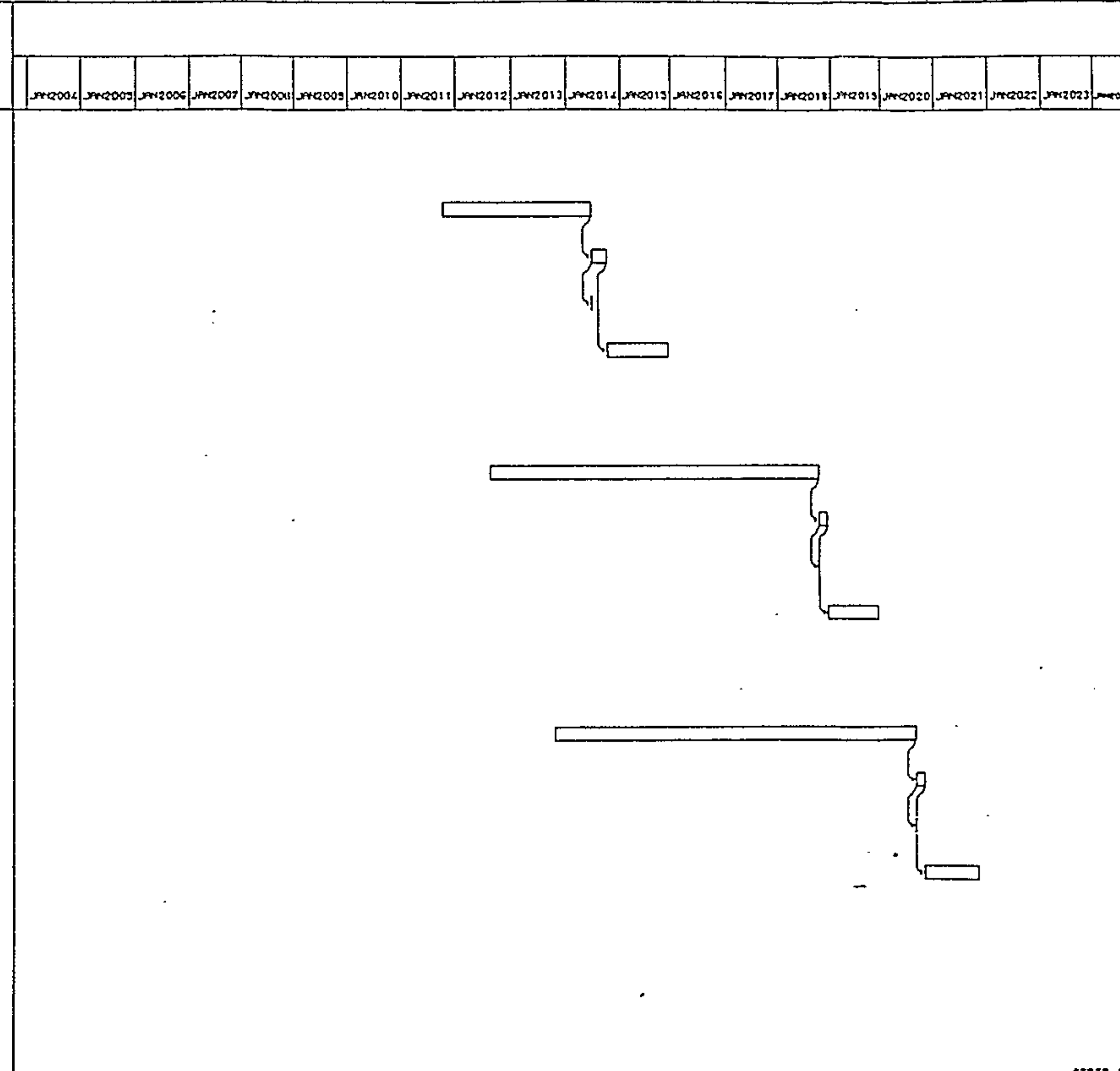


Table A12-B. Schedule for Tank Closure, Stabilization by Gravel (5 sheets)
(Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
SX-Retrieval	750 D
SXgravel	75 D
SXppu	1 D
SXbarrier	334 D
BY-Retrieval	1700 D
BYgravel	45 D
BYppu	1 D
BYbarrier	273 D
S-Retrieval	1900 D
Sgravel	45 D
Sppu	1 D
Sbarrier	276 D



STRIP 2

Table A12-B. Schedule for Tank Closure, Stabilization by Gravel (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
T-Retrieval	1450 D
Tgravel	34 D
Tppu	1 D
Tbarrier	322 D
B-Retrieval	1000 D
Bgravel	34 D
Bppu	1 D
Bbarrier	322 D
BX-Retrieval	450 D
BXgravel	32 D
BXppu	1 D
BXbarrier	270 D

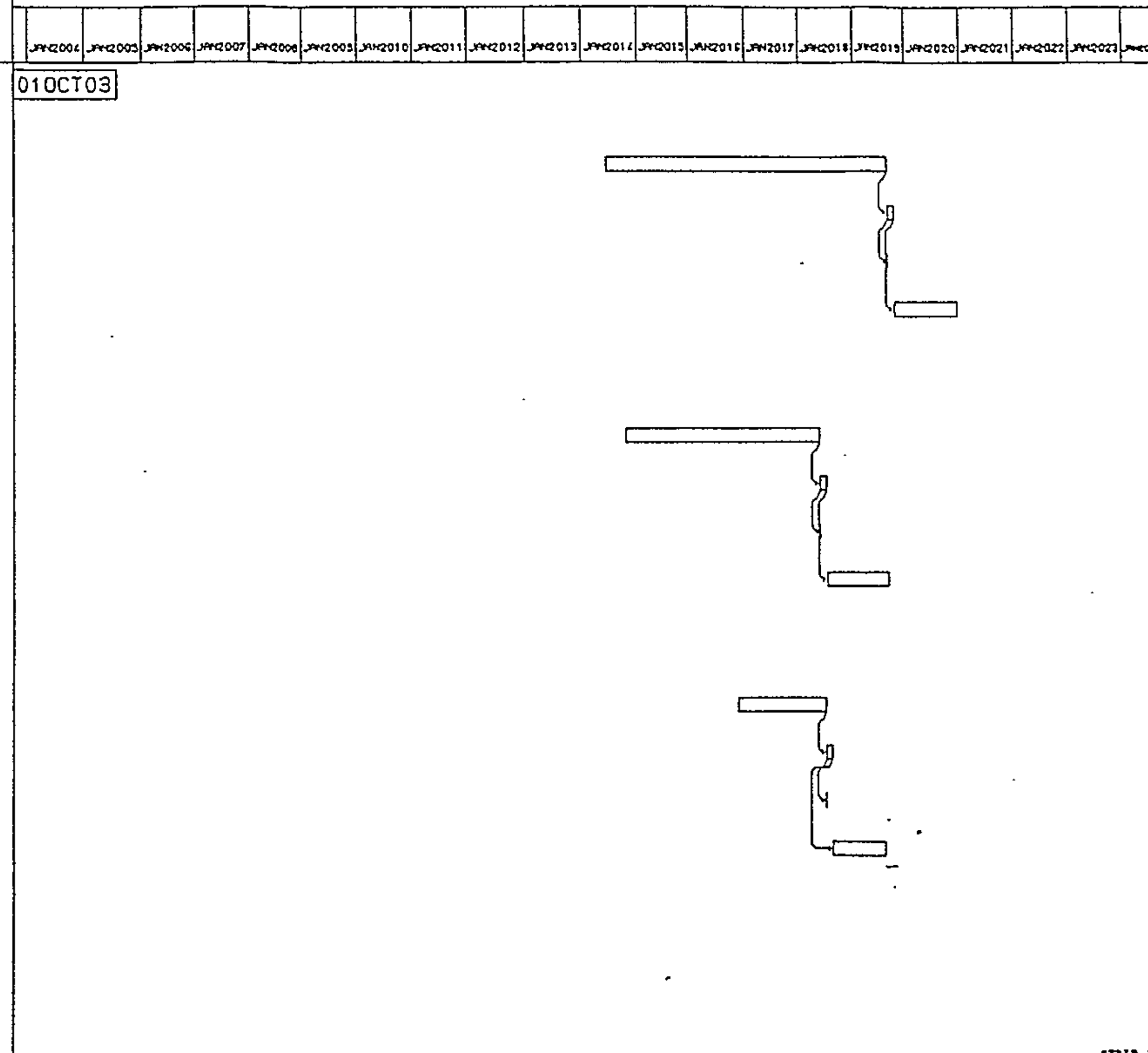


Table A12-B. Schedule for Tank Closure, Stabilization by Gravel (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
A-Retrieval	500 D
Agravel	30 D
Appu	3 D
Abarrier	160 D
TY-Retrieval	675 D
TYgravel	23 D
TYppu	1 D
TYbarrier	162 D
AX-Retrieval	275 D
AXgravel	40 D
AXppu	2 D
AXbarrier	120 D

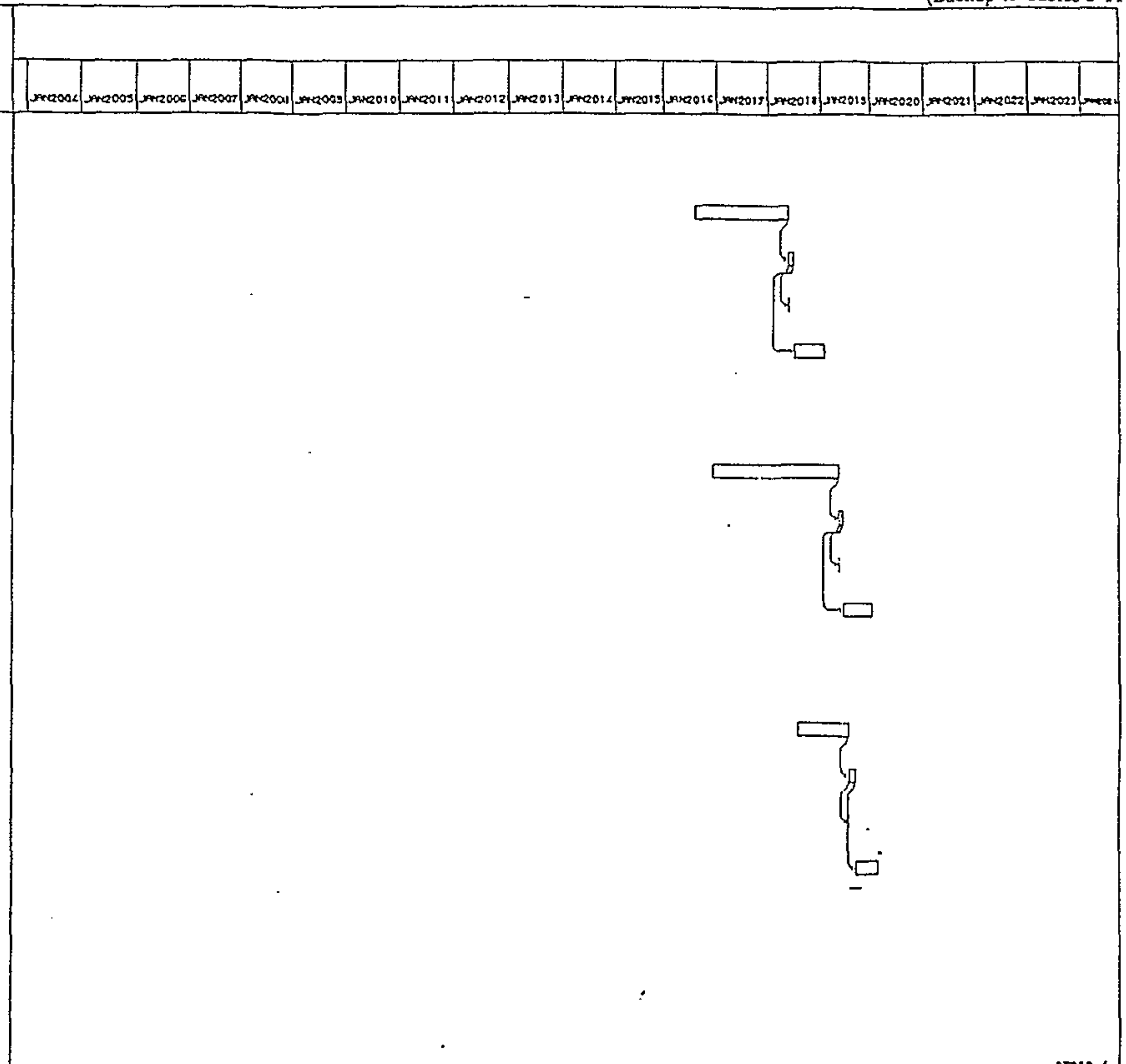
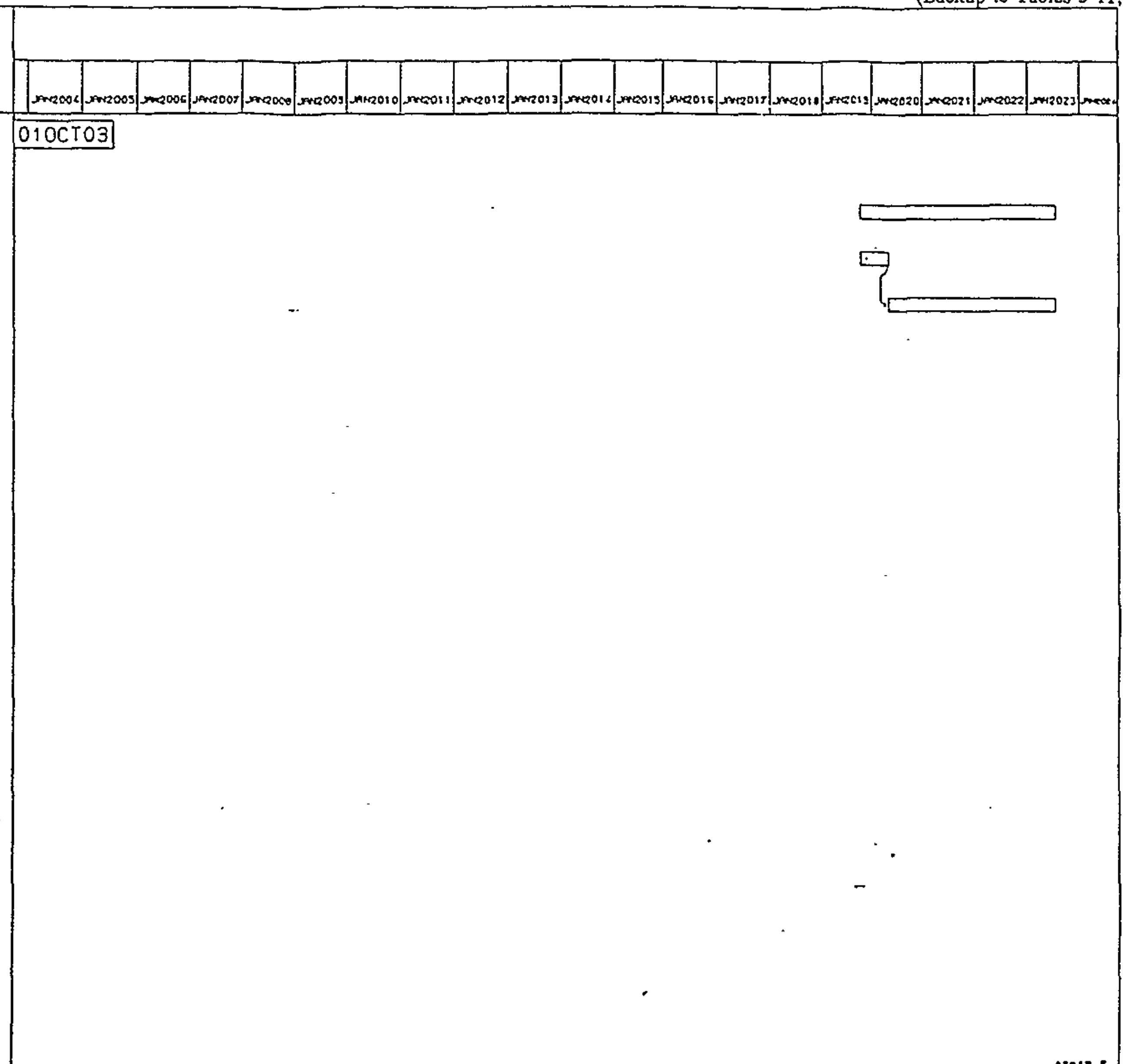


Table A12-B. Schedule for Tank Closure, Stabilization by Gravel (5 sheets) (Backup to Tables 5-11, 5-12 and 5-13).

Tank & Project	Duration
DSTanks	1052 D
DSTgravel	159 D
DSTbarrier	893 D



STRIP 5

9513385.0273

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	L. E. Borneman	Date July 21, 1995
Project Title/Work Order		EDT No. 612618
Data Package to Support TWRS EIS		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Central Files	A3-88	X (2)			
C. P. Bader	S7-51				X
L. E. Borneman	R2-06	X			
W. T. Dixon	H6-21				X
G. L. Dunford	S7-81	X			
B. G. Erlandson	H6-20				X
J. G. Field	G2-02	X			
E. A. Fredenburg	S2-48	X			
J. M. Garcia	R3-09				X
C. J. Geier	R2-36				X
C. A. Haass	S7-51	X (2)			
O. Honeyman	S7-81				X
L. Kline	H5-49	X			
J. L. Lee	R2-50				X
A. L. Ramble	H4-60				X
A. M. Umek	S7-81				X
J. Weber	S1-57				X
R. D. Wojtasek	S7-84				X
LEB File/LB	R2-06				X

RECEIVED
'995
0525

A-6000-135 (01/93) WEF067